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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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THURSDAY, SEPTEMBER 6, 1917.

THE PSYCHOPATHY OF THE BARBED WIRE.

Shell-shock and Its Lessons. By Prof. G. Elliot Smith and T. H. Pear. Pp. xi+135. (Manchester: At the University Press; London: Longmans, Green, and Co., 1917.) Price 2*s.* 6*d.* net.

THE conditions of modern warfare, with its trench life, its sudden gas and bomb attacks, the extraordinary intensity of newly discovered explosives, their variety, and also their long-continued effects when directed against human beings in a life-and-death struggle, have created among our men at the front such an amount of nervous and mental tension that the war has disclosed manifestations never previously anticipated, and the appellation to some of these states of the term "psycho-neuroses" is amply justified. These conditions are, however, rare in the trenches, although far from uncommon behind the lines, in the field hospitals, at the base, and especially at home. They occur also in labour battalions, and even among those who have never crossed the Channel. Nevertheless, we owe an inexpressible debt to all our menfolk in the line; they have suffered long and endured many things with the dogged determination to win victory for liberty, social justice, and human brotherhood. The price we pay for deathless courage and for records of supreme self-sacrifice on the part of officers and men, who lay down their lives to guard our homes and to protect our and their own flesh and blood, implies an intense stress and strain, resulting in many instances in a complete breakdown of mind and body; yet the proportion of mental cases is not so large as might have been expected, although their number in the aggregate with so great an army is naturally high.

This little treatise of five short chapters, designated "Shell-shock"—it would have been more accurate, we think, to have called it "War-shock," for the conditions described have been witnessed in cases that have not been to the front—purposes to give an account of some of the nervous and mental states associated with the war, and it has several lessons to teach. Most noticeable is the changed relationship here accepted between the mind and the body, for in place of the usual psycho-physical parallelism (of which Wundt was the chief pre-war exponent), which affirms that there is no causal relation between the processes in the one series and those in the other, we now have the view put forward that there exists a reciprocal causal relation between the two—but with stress laid upon the psychical series. It is assumed by the authors that a cerebral disturbance (physical) is caused by an object through the organs of sense, which gives rise to a sensation (psychic), and this, when cognised, causes a feeling or an emotion with a conative tendency (psychic), resulting in some further cerebral disturbance (physical), which eventually results in a motor reaction. This, in short—if the reviewer rightly interprets the meaning implied—is the view taken by the joint authors, one of whom is a distinguished anatomist and the other a student of psychology, both being guided in their new field of experience by the able psychiatrist to whom the volume is dedicated.

The essay is characterised by three main features: first, as stated, the tendency throughout to magnify as the predominant partner the first element in the psycho-physical relationship and therefore tending to dwell, we think unduly, upon the value of suggestion, dream analysis,[1] hypnotism, "psycho-analysis," and personal magnetism, nothing being said of massage, electricity, or baths; secondly, the great stress laid upon nurture rather than nature, which shows the authors to be out-and-out environmentalists; and thirdly—which does not appear to follow as a corollary from a disquisition upon "shell-shock"—the constant effort made to convince the public of the necessity for reform in the treatment of the insane, the urgent need for reconstructing the administra-

[1] See also "Dream Psychology." By Maurice Nicoll. (London: H. Frowde, and Hodder and Stoughton.)

tion of English asylums for this purpose, and the compelling want that exists for relaxing the Law of Lunacy, so that cases of insanity may be treated in the unconfirmed stages without the legal certificate—the latter certainly an example of preaching to the converted, as there were two Bills before Parliament for this purpose at the commencement of the war, and the London County Council has since obtained the sanction of law for the treatment of mental illness during its early stages in the Maudsley Hospital, now employed for military mental cases.

It may be stated here that the authors show a lack of practical knowledge of the law as applied to the insane poor—in whose interests the book pleads—when they state that the granting of the reception order is conditional upon the friends of the insane poor visiting from the outside world. This reception order really only applies to private patients—the richer of the community—and the long experience of the reviewer recalls regulations to limit the number and frequency of visits to asylums for the insane poor rather than the reverse. Nearly one-half of the essay is devoted to the third feature, and, as stated in the introduction, the object of the volume is to rouse a feeling against "the British attitude towards the treatment of mental disorder." Naturally, therefore, and also avowedly, the work is written for the general reader, and not for the medical practitioner,[2] and so far as the experience of the authors is concerned it is an exceedingly interesting essay; but we cannot subscribe to its views, especially in regard to heredity. We find this statement: "The war . . . has warned us that the pessimistic, helpless appeal to heredity so common in the case of insanity must go the same way as its lugubrious homologue which formerly did duty in the case of tuberculosis. In the causation of the psycho-neuroses heredity undoubtedly counts, but social and material environment count infinitely more."

In the reviewer's experience, which has been considerable with this class, a family history of insanity, epilepsy, paralysis, neurasthenia, or parental alcoholism has been obtained in 33 per cent. of all cases of shell-shock, and probably the correct proportion is much higher. As those who investigate in this field of inquiry know, the admission of insanity occurring in the family is not readily made, owing to the stigma attaching to it, and pedigrees ascertained are of the briefest kind. In order to be of value the family history should not only enumerate all the members, but also embrace at least three generations. In the absence of this information it would be incorrect to state that shell-shock cases presented no neurotic family history. In regard to heredity we know that the interaction of any two sets of characters may be conditional upon the presence of some third one, such as sex, as in hæmophilia, and in certain other diseases which appear in first-cousin marriages, and the character upon which these depend being recessive, the diseases would not appear, therefore, until two similar hybrids, each possessing this character, had intermarried. If the disease be rare, two such hybrids are not likely to meet unless they are of the same family, yet there exists a deeply seated defect which is highly hereditary. We have no definite knowledge of what is inherited; it may be the faulty nutrition of some ancestor, some "inborn error of metabolism"; at any rate, it is some deeply ingrained defect only curable by extinction of the stock or by its repeated crossing with other more stable stocks.

We think, therefore, that the authors assert too dogmatically that "there is no anatomical, pathological, or chemical evidence of inheritance in the cases of psycho-neuroses" which they had treated. Surely this evidence would not be necessary in order to prove the inheritance of disease, which is not ascertained by microscopic or chemical evidence. These conditions are known much more by perverted nervous action than by coarse structural lesions or chemical reaction, and we know that melancholia, epilepsy, paranoia, hysteria, and neurasthenia are not only interchangeable among themselves, but also definitely inherited, which indicates some deep underlying nervous defect. The reviewer is of the school which regards heredity as a great factor, and he believes there are few cases of shell-shock which do not inherit in their nervous system some *locus resistentiae minoris*, which has tended towards a breakdown at some age or other under the necessary stress. The comparison made by the authors between the heredity of tuberculosis and that of insanity is scarcely to the point, for in one instance the disease is of microbic origin, whilst in the other it is not. However, the authors are men of science who deny that there can be a true inheritance of any microbic disease, but observation and experience can best supply the test answer in regard to this, and there are few practical physicians who are not prepared to admit that the body in which the germinal plasm is lodged, if deeply affected by exhausting disease, may produce far-reaching effects upon this plasm, and consequently upon the offspring, so that a lower resistance to disease, or a greater proclivity or susceptibility, is probably transmitted, and the reviewer thinks it is not too much to affirm that this lowered resistance may be perpetuated—a thesis which cannot to-day be denied.

The reviewer is scarcely in agreement with the authors, who adopt so wholeheartedly the exclusively emotional origin of shell-shock as against the physical origin. That shell-shock is entirely of psychic origin and can be overcome by psycho-therapeutics is too sweeping a statement. In many, if not in most, of these cases there are physical weariness, fatigue, exposure, insomnia, exhaustion, and irregular meals—possibly also on occasion malaria and venereal disease; the reviewer has known these. Moreover, the state of the vital organs—the heart with its peripheral extensions, the lungs, and the alimentary system,

[2] See also "Psycho-névroses de Guerre." By Drs. Roussy and Hermitte. (Paris: Masson et Cie.)

together with the condition of the great eliminating organs, the liver, kidneys, skin, and bowels—are abnormally affected by life at the front—factors which must control the psycho-physical connections.

We know that intellectual and emotional manifestations depend greatly upon changes in the blood, in the internal secretions, and in the vital organs, but the authors seem not to recognise fully the implications connected with such physical changes, or they appear to underrate them, yet we have daily proof of their importance; witness the influence upon the emotions of visceral derangements, of changes in the circulation, or in the supply and distribution of blood to the great depurating organs. The brain must depend for its normal action upon the healthy co-operation of all the vital functions, and although the biological response of fear is of far-reaching importance, mental influences are not always the predominating factors in the causation of shell-shock, which may be more the result or the consequence of physical changes. The highest intellectual and emotional powers by which well-balanced adjustments are reached and well-balanced feelings are maintained require a full flow of nervous energy from all the bodily organs acting with unimpaired harmony, and whilst mental influences, positive and negative—exultations and agonies—count for much in the soldier's life at the front, the bodily state must not be neglected if the partnership is to prove effective. ROBERT ARMSTRONG-JONES.

SCIENTIFIC HOME-MAKING.

(1) *The Mothercraft Manual.* By Mary L. Read. Pp. xviii+440. (London: George G. Harrap and Co.) Price 5s. net.

(2) *The Home and the Family: An Elementary Text-book of Home-making.* ("The Home-making Series.") By Prof. Helen Kinne and Anna M. Cooley. Pp. vi+292. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 3s. 6d. net.

(3) *Food Gardening for Beginners and Experts.* By H. Valentine Davis. Pp. vii+44. (London: G. Bell and Sons, Ltd., 1917.) Price 6d. net.

(4) *One Hundred Points in Food Economy.* By J. Grant Ramsay. Preface by Prof. W. D. Halliburton. Unpaged. (London: G. Bell and Sons, Ltd., 1917.) Price 1s. net.

(1) THE author of "The Mothercraft Manual," who is a director of the School of Mothercraft in New York, complains that the word mothercraft is coming into general use, especially in England, in a much narrower sense than it was intended to bear. Certainly the aim of her book is a wide one. It is, briefly, to make available to "home-makers, present and prospective," some of the wealth of knowledge gained by students of biology, hygiene, child-psychology, and other sciences by translating it into the language of everyday life.

The early chapters deal with the evolution of marriage, the duties of the State and of parents so that reasonably early marriage may be possible, the establishing of the home on small means—a sense of humour is named as one of the chief essentials—preparation for parenthood, and the present state of knowledge of heredity and eugenics.

The last sections are too much compressed to be of value in themselves, but a bibliography to each chapter is appended, and one of the avowed objects of the book is to enable the student to follow out in more technical works any of the subjects touched upon. The most advantageous age for parenthood is stated to be twenty-five to forty for the mother and "over twenty-five" for the father; "two or three years" should elapse between births; four children are required on an average to maintain the family, but ethical control on the part of the parents is the only method of limitation consonant with the highest ideal of matrimony and with the welfare of the child.

The keynote to the section on growth and development is, that to live fully the life normal to any particular stage is the best preparation for the succeeding one. Many charts and tables of normal physical and mental acquirement at different stages are given, and these will be useful as a guide to fresh observation.

The practical part of the book begins with a discussion of the health, habits, and general well-being of the mother and the influence of these on pre-natal life. Much space is devoted to the actual care of the infant, and its daily, indeed hourly, *régime* from birth onwards is mapped out with meticulous care. In regard to the food tables our chief impression is that the stomach of the American infant must be very different from that of the kind of baby we are accustomed to if, at eighteen months, it is advisable to add to its dietary a *purée* of fresh or dried peas, celery, onions, or corn, or if the following is a "typical" midday meal for a child of six: Half portion macaroni, one tablespoonful cooked cheese, four tablespoonfuls string beans, lettuce with oil and lemon-juice, bread and butter, and a raw apple! The tables of food composition, however, are very clear and of general applicability.

The succeeding chapters deal with the education of the child in the home, and they follow in the main the now familiar principles laid down by Froebel, Stanley Hall, Prof. Dewey, and Mme. Montessori. The value of play as a factor in education is recognised, and we are glad to see that no great regulation of play, as distinct from games, is recommended. Abundant playthings suited to the visual capacity and muscular development at each stage are enumerated, highly finished toys which leave nothing to the resource and imagination of the children being ruled out. Organised games should begin at about four years old, and can be used as a training in group-action, in competition, loyalty to a leader—in short, to lay the foundations of nearly all the civic virtues.

The place of story-telling, of music, and of the arts in home education is considered, and the book closes with a section on home nursing and first aid. Some of the illustrations are useful and interesting; others, such as a tableful of labelled bottles of unwholesome sweets, have rather an irritating effect.

(2) It is open to question whether it is well that the attention of young women should be concentrated too closely and continuously on the problems of home-making and child-rearing unless they have a definite prospect of marriage, or of putting the training to practical account in some other way. But a basis of general knowledge of the home-making arts is necessary to every woman. This, and the perception that there is a high standard to be reached, can be gained comparatively early in school life, perhaps best between the eleventh and fourteenth years. Therefore we welcome very warmly an "Elementary Text-book of Home-making" by Prof. Helen Kinne and Anna M. Cooley, both teachers of the subject in Columbia University. The book, which is American in its setting, is written in story form, and is intended for use as a supplementary reader in elementary schools. The directions for the sanitary arrangement of the house, the furnishing and cleaning of rooms, the care of the baby, and the preparation of food are clear and simple. Emphasis is laid throughout on the duty—and the means—of simplifying life and economising labour that a higher degree of mental health and physical efficiency may be reached by the maker of the home, as well as by its other inmates. The "typhoid" fly has a chapter to itself, and an optimistic picture, published by permission of the Louisiana State Board of Health, shows a child, in the year 1920, gazing at a fly on the edge of its plate and asking interestedly, "What's 'at?" If anything could bring about so desirable a state of things in so short a time, it would surely be the dissemination of the terrifying figure on the next page of a fly the legs of which are festooned all over with germs "greatly magnified."

(3) Vegetable culture has become a very important homecraft in these days, and this little book, "Food Gardening for Beginners and Experts," will be found a useful guide. It gives very simple directions and diagrams for arranging a plot or garden in three sections, so that each is heavily manured and limed once in three years. Tables show the proper rotation of vegetables for each section, and brief instructions are given for the culture of each kind. A calendar of garden operations is appended, but no guidance is given as to the probable differences of time for seed-sowing in various parts of the country.

(4) "One Hundred Points in Food Economy" is stamped with the approval of Prof. Halliburton, and in these days of tabloids it may make some appeal. We quote one "point": "Food substitutes are not to be despised. *Why?* Because many of them are equal, or better, than the food they are intended to substitute, but, on account of ignorance, prejudice, or habit, they may not be so popular." *Why* should anybody write English like that?

M. R. T.

SPECULATIVE ANTHROPOLOGY.

Modern Man and His Forerunners: A Short Study of the Human Species, Living and Extinct. By H. G. F. Spurrell. Pp. xi+192+illustrations v. (London: G. Bell and Sons, Ltd., 1917.) Price 7s. 6d. net.

IT may be at once admitted that the author of this book is a daring and original thinker, who has used man, ancient and modern, as a stalking-horse to cover a series of essays dealing with the origin and fate of man and of man's highest form of modern civilisation. The author, had he so chosen, is well qualified to write a book on modern man and his forerunners; he has made notable contributions both to anatomical and to medical literature; as a physician he has resided in South America and West Africa. Indeed, the very best parts of his book are those in which he records his studies of the habits and psychology of apes and monkeys. His interests, however, are centred, not on the anatomical features of species of man and ape, but rather on those mental characters which come into action when individuals become grouped in herds and communities.

Dr. Spurrell pictures three selective phases in modern man's evolution. In the first and earliest phase man's struggle was with his environment, the fittest individuals surviving. In the second, that of primitive communities, the struggle was with other communities. "The object of such a community," says Dr. Spurrell, "is not to promote the survival of the fittest, but to fit as many as possible to survive." In the second phase selection was no longer individualistic. In the third phase, when primitive communities have become welded into nationalities by the introduction of those conditions of life to which the author would restrict the term "civilisation," the form of selection again changed. "At the beginning of civilisation the individual method of selection again came into play. Individuals with a greater capacity for civilisation had a greater chance of surviving and leaving children to carry on their qualities." Civilisation tends to favour the survival of the rapacious, selfish individual. "The basic weakness in civilisation," writes Dr. Spurrell, "lies in the deeply rooted predatory instinct in human nature."

From such quotations it will be seen that Dr. Spurrell is not optimistic about our future. "The ultimate extinction of man is, of course, as inevitable as was that of the innumerable species with whose remains geological strata are packed," is a sentence from the last page but one. Yet the author has many clever and mordant statements to make. "It is the fittest armies which survive war, not the fittest individuals." "Civilisation is essentially a slavery, the need of money being its whip." "What the masses want when

they profess themselves socialists is ease without effort." "The advertisement of cheap and painless substitutes for war has been a recurring feature in the cycles of civilisation." We suspect that the author has a sense of humour hidden away somewhere and that perhaps he does not really mean all he says.

IDENTIFICATION OF PLANTS.

Name this Flower: A Simple Way of Finding out the Names of Common Plants without any Previous Knowledge of Botany. By Prof. Gaston Bonnier. Pp. xii + 331 + plates 64. (London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co., 1917.) Price 6s. net.

THE desire to know the names of wild flowers is very widespread and by no means confined to those who take any particular interest in botanical science. For such as these there has been no easy book of reference. The simple books have all been written on botanical principles, and the science of plant classification underlies almost every so-called popular treatise.

Prof. Gaston Bonnier has fully realised this, and in producing his book, "Name this Flower," has achieved a really useful purpose. At first the botanist may be tempted to scoff and consider it a wasted effort, for the construction of the admirable keys must have been a most laborious work. But a little study reveals its great value, and a test with such difficult plants as sea holly or teazel shows how thoroughly the work has been done.

In writing the book Prof. Bonnier was largely influenced by the philosopher Ernest Bersot's "Letter on Botany," published among his "Reflections of a Moralist." "Botany," he says, "is one of the most deceitful of sciences. As flowers are so charming one imagines that it also must be charming; but how soon one is disillusioned! And why? Ah, why? Because the *savants* have thought about themselves and not about us. They have wished for a science complete in itself; and they have put each thing in its place without troubling to ascertain whether it would be easy for other people to find it there. How many times have I tried to become a botanist, and each time I have been vanquished."

Prof. Bonnier, by his exhaustive keys, well illustrated by line drawings, enables anyone to find out the names of plants without knowing anything of botany or of the principles of classification. The value of the book is enhanced by sixty-four plates of coloured illustrations, which represent the plants sufficiently adequately. A good deal of botanical and general information is also packed into the book, and it is very well indexed. Anyone using Prof. Bonnier's book carefully could scarcely fail to find that in so doing he had not only learnt the names of plants, but was also being impelled on the high road to become a botanist.

English students should be grateful to Prof. Boulger for this translation of Prof. Bonnier's excellent book.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Unusual Rainbows.

THE very interesting diagram sent to NATURE for August 30 (p. 525) by Mr. Allan Low seems to exhibit a complete system of direct and reflected rainbows. The falling raindrops would be flooded with the direct light of the sun, forming the usual pair of bows. They would also be flooded with the light reflected from the surface of the sea; if the sea is not ruffled this latter light would be directed from a fairly concentrated image of the sun, below the horizon. Thus it should show another pair of bows, the common axis of which is the prolongation of the line from the observer to this image of the sun; as that line points above the horizon, these bows should be more than a semicircle in extent. When the surface of the sea is ruffled, the blurred image of the sun will be so large that the colours in the bows will overlap, and only a broad white bow will appear, which would not be noticed. Fog bows are white for a different reason. The two systems of bows meet at points which must be equidistant from the sun and its image; for bows of the same radius these points must be on the horizon. The altitude of the anti-sun, the radius of the bow drawn to the horizon, and the horizon form a right-angled spherical triangle; thus the sine of half the angle between two bows where they intersect on the horizon is equal to the sine of the sun's altitude divided by the sine of the radius of the bow. With Mr. Low's estimated figures this would bring out the radius rather too small. J. L.

Cambridge, August 31.

THE arcs of the third and fourth bows, so well described by Mr. Low in NATURE of August 30, are, I think, undoubtedly due to the sun reflected from the ocean behind the ship.

Around a centre O describe two circles with radii of 42 mm. and 52 mm. respectively. Then 7 mm. above O draw a horizontal line. This will represent the horizon, and the portions of the circles above this will be the primary and secondary bows due to the direct light of the sun. On a line from O, perpendicular to the horizontal line, take another point P, distant 14 mm. above O, and describe circles about P with radii as before. The portions of these circles above the horizontal line will be the primary and secondary bows due to the reflected sun. It will be found that the figure thus obtained is very similar to that given by Mr. Low, except that he saw only small portions of the third and fourth bows. But I believe the sun's altitude must have been greater than 7°, for with that height only about one-sixth of the vertical radius of the primary bow would be below the horizon, and in his diagram about one-third is cut off. I have taken the radii of the primary and secondary bows as about 42° and 52°, in round numbers.

Invermay, Hyde Park, Leeds, August 31.

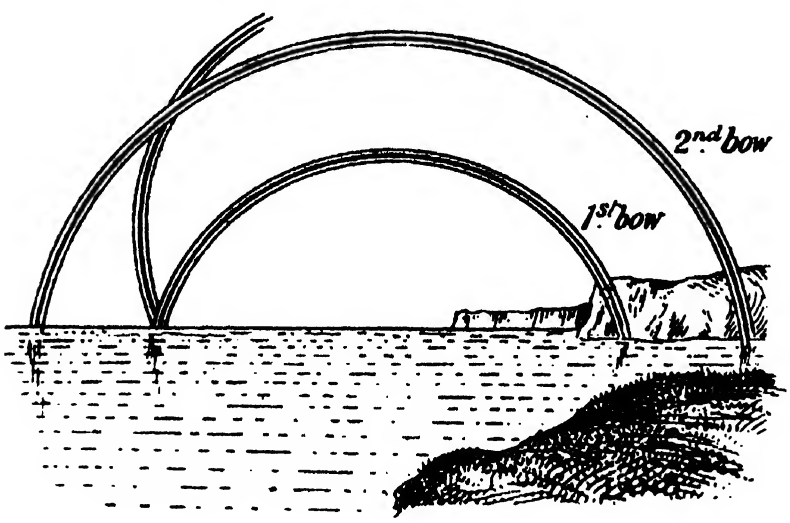
C. T. WHITMELL.

THERE seems to be a simple explanation of "An Unusual Rainbow" described by Mr. Low in NATURE of August 30. If the sea was sufficiently calm th would be, from the point of view of the raindr causing the rainbow, a real sun 7° above the horizon

and also a mock sun 7° below it, caused by reflection. The primary and secondary bows caused by the latter as source would occupy exactly the positions indicated in the sketch with the appropriate colour arrangement. As the intensity and definition of the mock sun, good at grazing incidence, would fall off rapidly as the angle increased, only the lower part of the bows would be distinctly visible; this also is suggested in the sketch. The calmness of the sea is not specifically mentioned, but seems to be implied by the other weather conditions stated. F. W. ASTON.

South Farnborough, August 31.

THERE was observed over the Medway estuary on August 18 (7.15 p.m., B.S.T.) an extremely brilliant rainbow. In addition to secondary bows concentric with the primary (all less than a semicircle), there was seen a bow of considerable brightness having an arc greater than a semicircle. This "anomalous bow" appeared to be of the same radius as the primary bow, had its colours in the same order (*i.e.* red outermost), and cut the horizon at the same point. It was, in fact, the remainder of the circle of which the primary arc formed a part.



The bow in question presumably originated from the image of the sun reflected in the still water of the foreground, and thus the right-hand end of the primary bow, which stretched overland, was unaccompanied by the eccentric arc. The phenomenon should not be an uncommon one, yet I do not remember to have observed it previously. W. NEILSON JONES.

Grain, Kent, August 18.

The Sounds of Gunfire.

THE recent correspondence in the *Times* referring to the audibility of the reports at great distances induces me to record my experiences here. I have a garage, built of corrugated iron and lined with matchboard. It stands on a concrete base, and the floor is cemented. Its dimensions are 20 ft. by 10 ft., by 15 ft. to the ridge. I can hear the sounds of the guns inside the building on days when they are inaudible outside. When audible outside they are considerably accentuated within.

The same thing occurs in the case of a smaller shed, of similar construction, about 100 yards away.

A structure of corrugated iron and wood upon a concrete base appears to act as a resonator, collecting and intensifying the sounds. It might be possible to record the sounds on wax cylinders (phonographically) by using an abnormally large megaphonic trumpet directed towards the source of the disturbance.

C. CARUS-WILSON.

Strawberry Hill, Middlesex, August 27.

EDUCATION AND INDUSTRY.

DURING the early part of 1916 the Higher Education Sub-Committee of the Education Committee of the London County Council devoted a great deal of time to interviewing representative employers with the view of obtaining their views on the efficiency of the work done in the various types of educational institutions under its control, and a frank discussion of the relations which should exist between the education given in them and industrial and commercial life. The results of these interviews are summarised in a report recently presented to the Council, which has roused a good deal of comment in the Press, much of it of a very superficial character.

Most of those interviewed were concerned with the distribution and transport of goods or with financial undertakings, but, in addition to these, three groups of employers dealing with what may be said to be the three main London manufacturing industries, engineering, printing, and the chemical trades, were also interviewed.

While the inquiry was generally directed to the possibility of establishing a closer relationship between education and industry than at present exists, the main lines on which it proceeded may be summarised under four heads:—

(1) The methods adopted by business men for recruiting their staffs and the qualifications demanded from applicants.

(2) General defects in the education given by the schools as revealed by the experience of business men.

(3) The possibility of greater assistance being given to employers in making a suitable selection and in providing better material.

(4) The encouragement given by business men to further education of their staffs, and the desirability or otherwise of compulsory further education.

With the criticisms of the representatives of commerce we do not propose to deal beyond remarking that they are largely criticisms of the character and *moral* produced by the schools, and the most sweeping of them have been shown by the events of the last three years to have very slight foundation. For many of the others the conditions of employment, and particularly of the methods used for selecting employees, which in too many cases pay far too little attention to the selection of the really able and intelligent boy and far too much to personal influence, are much to blame. If a boy in his last years at school feels that someone whom he knows will get him into a post and that it matters very little whether he does his school work well or badly, he has little encouragement to put forth the best that is in him.

The engineering group of trades forms the most important group of manufacturing industries in the London area: few people realise that nearly three-quarters of a million persons are dependent upon it.

The representatives of this group showed a refreshing belief in continued education; they all

felt that elementary-school education is insufficient, and that education and workshop practice should go hand in hand; they expressed a decided opinion that to be effective any scheme of continued education for the ordinary boy must be compulsory, so as to protect the good employer. In this group of trades the provision for technical education hitherto made has been more complete than in any other, and it is in this group that the country has best held its own against foreign competition.

As regards the curriculum of the technical schools, recommendations were made to widen the scope of the training to include the colloquial teaching of foreign languages and some economics. The question of costs and estimates also needed attention.

It was stated that the ever-increasing demands of the industry called for a larger supply of suitably trained men, and that every chance should be given for the best men to reach the highest institutions, which should be well equipped and well staffed.

The representatives of chemical industries were not so completely in accord with each other. The practical man was inclined to think that works experience, aided by technical classes, was sufficient; the university-trained man believed that nothing short of a full university training was of much use. The industry was said to need three distinct classes of workers: the research assistant, the foreman and technical chemist who supervises the manufacturing operations, and the semi-skilled or unskilled labourer who does the routine work. The first class has found less employment in England than in Germany or America, and this was said to be due to several causes. In Germany research is subsidised and encouraged by the State to an extent quite unknown in England, and the chemical industry is in the hands of large firms, who are willing and can afford to incur expenditure upon research. In England, on one hand, teachers are said to be too little in contact with industry, and, on the other, manufacturers expect too much from the young chemist, and do not realise that until he has had some business experience he cannot be reasonably expected to produce startling improvements.

The printing trade group of employers also are believers in technical education, and they referred to the value of the research work in connection with the photo process industry which has been carried out at the Photo-Engraving School at Bolt Court.

As a result of these conferences two important proposals are made by the sub-committee—(1) to create an Appointments Sub-Committee, which shall do for the secondary and elementary schools what the Appointments Boards are now doing for the universities; and (2) to form consultative committees of experts chosen by the Council for various branches of commerce and industry to advise the Council upon the equipment of institutions and upon the distribution, development, and modification of courses of instruction relating to the industry concerned. Such a committee is already in existence for the printing trades, and committees are to be formed for the engineering and chemical trades. If only the right persons are chosen, and if the Council pays proper attention to their recommendations, this step should prove fruitful of good results.

There is an uneasy feeling abroad that the present Council is not really in earnest in regard to this matter of technical education, and that many of its influential members do not look upon education as a profitable investment which will make large returns, but rather as something which they must perforce appear to attend to in order to keep faddists from troubling. The old Technical Education Board, which had a somewhat independent existence and did a great work for technical and scientific education in London, came to an end when the Council became the Education Authority in 1904. Since then the claims of technical and scientific education have been much in the background; the able officer who advised the Board in such matters was quietly shunted; and there has been a tendency to restrict unduly expenditure on equipment and, under the plea of concentration, to hinder the development of institutions doing good work.

When the Technical Education Board went out of existence plans had been prepared for an institute of technical optics, and these were left in a forward state to be carried out by the new authority, but under one plea or another their execution was repeatedly postponed. What this postponement has meant will only be known in years to come, when the full story of the present world-conflict can be told. Now, under the stress of national need, steps have been taken, but it will yet be some time before they can produce their full effect.

Similar remarks apply to provision that was contemplated for the erection and maintenance of technical institutes to serve North-East and South-East London. Both these much-needed schemes, providing for important industrial areas, have been under discussion for more than ten years, and we believe that plans have actually been prepared for the necessary buildings and equipment, but from one cause or another nothing has as yet been done in either case to carry them out. It is to be hoped that the new consultative committees will not be used as an excuse for further delay.

The root of the whole difficulty lies in the fact that the average member of the Council has little belief in education, and, if anything, less belief in the value of science; and until this attitude of mind is altered no amount of new machinery is likely to bring about improvements of any value.

There are indications that the necessity for encouraging research is likely to be more appreciated in the future than it has been in the past. It is to be hoped that in making important staff appointments, especially appointments to principalships of large technical schools, more attention will be

paid than hitherto to proved ability of this character; that the staffs of technical institutions should be not merely allowed, but expected, to undertake original research; and that they should not be so overburdened with other duties as to leave them little time and energy for such work.

NATIONAL WORTH OF CHEMICAL LABORATORIES.

WE have on several occasions during the past few months directed attention in these columns to the strenuous efforts America is now making to take the fullest advantage of the opportunity afforded by the present condition of things in Europe to improve and enlarge such of her industries as are directly dependent upon chemistry. On all sides we see the evidence of her determination to render herself independent of the hold which Germany, by means fair or foul, has sought to obtain over her, to the detriment of her commercial development. But energetic and far-sighted American manufacturers have even a wider outlook than the supply of their home markets. They are out for wresting from Germany the pre-eminence she has hitherto been able to secure by combinations and financial arrangements of a shady complexion in the markets of the world, and there is no question that the industrial magnates of Germany are now seriously alarmed at the prospect. The recent political crisis in Germany is a sure sign of this fact, and the industrial and military autocracies have still further cemented their union in the effort to meet it. The present struggle will inevitably develop into an economic warfare of the most bitter and relentless character. All this is clearly foreseen by all the more important industrial communities. The very method by which Germany is conducting her share of the war is an indication of what she intends her economic policy to be in the immediate future.

In an address delivered at the dedication of the chemical laboratory of the University of Oklahoma, reproduced in our contemporary, *Science* (July 6), Prof. W. A. Noyes, of the University of Illinois, has admirably defined the relation of the research laboratories of the American universities to the coming struggle. They are the training schools in which the prospective combatants must receive the equipment upon which success alone depends. Economic warfare, in the long run, is a far more complicated business than a military campaign, and its ultimate and permanent triumph rests upon many factors. But, under modern conditions, it fundamentally depends upon the efficient application of scientific principles and upon the aptitude to turn the knowledge gained by scientific research to practical account.

Prof. Noyes illustrates these facts by examples, familiar enough to all who are cognisant of the course of industrial development during the past six or seven decades, but which cannot be too often dwelt upon. They are lessons to be instilled into each succeeding generation, and which they must never be allowed to forget. He begins with the creation of the Giessen laboratory, and traces its influence upon the growth of scientific chemistry all the world over, and its special influence upon the development of applied chemistry in Germany. Incidentally he contrasts the difference in the trend of events in England. We had an enthusiastic and inspiring teacher in Hofmann, actuated by the spirit and example of Liebig, who had unquestionably a powerful stimulating effect here; but much of the good seed fell upon stony ground so far as it permanently affected the character of our chemical industries, and the stimulus of Hofmann died with his recall to Berlin. The manner in which we threw away our opportunity in discarding the new industry which Hofmann and the associates he gathered round him created is one of the saddest stories in our economic history. We are now realising only too bitterly what the loss of that industry has meant, not only to our manufacturing supremacy, but also to the rapid and successful prosecution of the war. The moral of this lesson will, we may hope, not be lost upon the young community to which it is addressed.

Prof. Noyes then rapidly deals with these questions as they affect his own countrymen. He points to the extraordinary development in the means of instruction in chemistry which the United States has witnessed in the course of a generation, to the spread of admirably equipped schools for higher instruction and research, and to the growing recognition on the part of the industrial community of the importance of scientific training in the conduct of manufacturing operations. But the full fruition of such efforts is, as with us, occasionally impeded by unwise legislative action, and Prof. Noyes gives examples of such action on the part of Congress, apparently at the instigation of persons acting in the interests of foreign firms. The practices of these firms are in direct contravention of the principles of the Sherman law, which forbids combinations intended to prevent real competition in the manufacture of staple products. But these combinations are deliberately fostered by the German Government, and branch establishments of powerful German firms settled in America are avowedly working against the spirit of the law in the effort to strangle the rapidly growing development of American chemical industry. There is an amusing story of how a characteristic instance of Teutonic bullying was effectually checked by a manufacturer who was largely concerned in the production of American bromine. The proverbial astuteness of our American cousins is frequently more than a match for the somewhat clumsy blundering of their German competitors. Show a firm front to the bully and he speedily collapses. But America wisely learns what she can from her enemies, assimilating the good and rejecting the bad, in her determination to organise the world on the basis of justice instead of force.

SOME RECENT DANISH MEDICO-HISTORICAL WRITINGS.[1]

DURING the last few years there has been a widespread revival of the study of medical history in many countries, and a considerable number of professorships have been founded to teach a branch of the curriculum which is considered by many to be invaluable from an educational point of view. Some medico-historical societies have also arisen in France, America, and England, and, judging by their literary output, work is going on very actively. The small but highly intellectual country of Denmark is not behind the others, as is seen in the issue, under the direction of Prof. Vilhelm Maar, of the University of Copenhagen, of an important series of small monographs which we have before us. Up to the present fourteen of these have been published and cover a wide field of medical historical research. They are the work mostly of Danes, chiefly of the University of Copenhagen.

Thus Finnur Jónsson (1), professor of Northern philology, gives an interesting account of various diseases in northern Scandinavia and Iceland in ancient times, of particular importance being his statements as to the wide geographical distribution of leprosy, small-pox, pulmonary and mental diseases. There would appear to be no records of syphilis, and, indeed, venereal diseases generally were but little known.

Kristian Carøe (2) has written a short account of the relation of the medieval bedell to medicine, and in particular to the practice of surgery. The exposition of the doctrines on the origin of mental diseases in the classical period has been ably carried out by Dr. J. L. Heiberg (3). Dr. Ernest Wickersheimer (4), the well-known librarian of the Academy of Medicine in Paris, continues the studies on the treatment of hydrophobia by sea-water which he had published some years previously. A very exhaustive account of trephining in primitive times comes from the pen of Dr. Søren Hansen (5), and is well illustrated. Ample justice is done to the fairly extensive literature extant on the subject. Dr. K. K. K. Lundsgaard (6) deals with the well-worn theme of the history of spectacles and eye-glasses, and brings the facts well up to date. In the seventh brochure Dr. J. W. S. Johnsson writes with knowledge and humour on medieval quacks and their advertisements.

Chr. Barfoed (8), in the compass of eighty-eight pages, has managed to dig deeply into the question of the laying on of hands in its religious and therapeutic aspects from ancient to modern times. The practice of the royal touch in England from Edward the Confessor to Queen Anne is dealt with at some length. Charles II. seems to have carried out this royal duty with great assiduity, for, at the rate of 3700 a year, he touched 92,102 sick persons between 1660 and 1682. After George I. the practice fell into disrepute in England. The relationship of "laying on" to Christian Science and its extraordinary modern dissemination is also dealt with.

Carl Jul. Salomonsen (9), the eminent professor of general pathology in Copenhagen, deals in his own characteristic way with the island of Cos and the home of Hippocrates, basing his work on the remarkably successful excavations carried out by Rudolf Herzog in 1902, which have added immensely to our knowledge of this insular home of the medical art.

One of the largest of Prof. Maar's series is a translation of Felix Platter's autobiographical reminiscences of his youth (10 and 11). Platter, as is well known, was one of a medical family of the name who added great lustre to the town of Basel in the Middle Ages. He himself was in practice there for a large part of the sixteenth century, and after his return from Montpellier was one of the first to dissect the human body and to teach the Vesalian anatomy. His autobiography, including as it does his journey to Montpellier and his study there, is an important contribution to the history of the time of the Reformation.

Of less purely medical interest is Axel Garboe's (12) work on unicorns and their relation to existing animals like the narwhal. Dr. Julius Wiberg (13) gives an elaborate account of the doctrines held among the ancients as to the causes, onset, and termination of crises and critical days in diseases—a subject which modern medicine has not yet unravelled in its entirety. The series closes with a small book by the late Prof. Ingerslev (14) on Dr. Ambrose Rode, a German doctor who practised first in Copenhagen and then in Christiania in the seventeenth century.

Prof. Maar is to be congratulated on having gathered together such an interesting amount of original material, and when more peaceful times come again it is to be hoped that he will be able to keep the historical flame burning in that small Scandinavian country to which we are bound by so many ties over so many centuries. W. B.

[1] "Medicinsk-historiske Smaaskrifter." Ved Vilhelm Maar. (København: Vilhelm Trydes Forlag.) (1) Finnur Jónsson: "Lægekunsten i den nordiske Oldtid": 1912. (2) Kristian Carøe: "Bøddel og Kirurg"; 1912. (3) J. L. Heiberg: "Sindssygdom i den classiske Oldtid"; 1913. (4) Ernest Wickersheimer: "Hundegalskab og Strandbade"; 1913. (5) Søren Hansen: "Primitiv Trepanation": 1913. (6) K. K. K. Lundsgaard: "Brillernes Historie"; 1913. (7) J. W. S. Johnsson: "Lidt om landefarernes og laegernes Reklame i Ældretid"; 1914. (8) Chr. Barfoed: "Haandspaalaeggelse"; 1914. (9) Carl Jul. Salomonsen: "Asklepios' Helligdom på Kos"; 1914. (10 and 11) "Felix Platters Ungdomserindringer, skildringer fra Basel og Montpellier i Reformationstiden, oversatte og udgivne af Thora Gertz"; 1915. (12) Axel Garboe: "Enhjørningen"; 1915. (13) Jul. Wiberg: "Kriselaeren i oldtidens Medicin": 1916. (14) E. Ingerslev: "Ambrosius Rhodius og hans Hustru": 1916.

NOTES.

ACCORDING to the *Chemist and Druggist,* Prof. E. Buchner, director of the Chemical Institute of Würzburg University, and Nobel Laureate in chemistry for 1907, has been killed in action on the Western front.

SENOR AUGUSTO VILLANUEVA, Banco de Chile, Santiago de Chile, has accepted the position of representative and corresponding member of the Ramsay Memorial Committee for Chile, and is taking steps to promote the objects of the memorial in Chile by the formation of a local committee and in other ways. The Ramsay Memorial Fund now amounts to

21,428*l.* 11*s.* 6*d.* Further donations can be sent to the honorary treasurers, Lord Glenconner and Prof. Collie, at University College, London (Gower Street, W.C.1).

THE Martell scholarship of the Institution of Naval Architects, which is of the annual value of 100*l.* and, subject to the regulations, tenable for three years, has been awarded to Mr. H. C. Carey, of Chatham Dockyard. The Earl of Durham prize of the same institution has been awarded to Mr. H. D. Leggett, of Portsmouth Dockyard.

WE learn from the *Scientific American* that a series of handbooks is to be published by the U.S. Geological Survey giving for the various military divisions of the country, in a compact form, information relating to their physical features, leading industries, transportation lines, and other matters of interest to the Army. The preparation and editing of the volumes have been entrusted to the committee on physiography of the U.S. Geological Survey.

ACCORDING to a report in *L'Echo du Commerce* for August 18, certain tests which were made some time ago with a view to the use of fuel made from olive residues gave such satisfactory results that the Tunisian Government, which has already commenced manufacturing the fuel in the form of briquettes, is about to increase its production. A tramway company and other important firms will use this fuel in their electric power stations.

WE regret to learn that 2nd Lieut. H. L. Foster, of the Royal West Kent Regiment, was killed on June 7. Mr. Foster was the son of the most distinguished horticulturist of his time, the late Mr. Charles Foster, who was for some years the head of the Horticultural Department of University College, Reading. He was educated at the Reading Collegiate School, and underwent the horticultural training at the Royal Horticultural Society School at Wisley. He was appointed assistant horticultural instructor under the Kent Education Committee, 1913, an appointment which he held until September, 1914, when he joined his Majesty's Forces. He obtained a commission in 1916, after having been severely wounded at the battle of Loos. Although still young, Mr. Foster proved himself one of the most promising of the younger horticulturists, and his death is a severe loss to the world of horticulture.

DR. J. R. TOSH, lately assistant professor and lecturer on zoology in St. Andrews University, has fallen (July) in Mesopotamia from "heat-stroke," when gallantly doing his duty. Dr. Tosh was a distinguished student, and after graduating in arts devoted himself, as became one in touch with the Dundee Museum from boyhood, to zoology. He carried out, very early in his career, fisheries' work at the old St. Andrews Marine Laboratory, and further developed a great aptitude for teaching. He then became a science teacher in schools, and carried out various researches, such as the investigation on the salmon of the Tweed, for the Fishery Board, making at the same time a collection of its parasites for a subsequent notice. He also studied the development, life-history, and economic aspects of the pearl shells. Later he was appointed marine zoologist to the Queensland Government, with special reference to the pearling industry, and he did much good work on Thursday Island. When he returned in 1905 he was made assistant professor and lecturer in his *alma mater*, and ably performed for nine years the duties as a popular demonstrator, skilled in all the modern technique and a great favourite with the students. He returned again to Australia to develop the pearling industry on lines of his own, coming home just as the war broke out to form a company on the basis he had outlined, but the absorbing interest in the war arrested progress. He then joined the field forces, and was suddenly cut off as mentioned, to the loss of science and the pearling industry.

MR. DONALD MACLENNAN, whose death was announced in NATURE of August 30, laid the foundation of a very profound knowledge of the shorthorn and other breeds in the Black Isle district of Ross-shire. Failing to make both ends meet in his native land, he emigrated in 1871 to the Argentine. Having made a small fortune as a stockman, he decided in 1881 to return to Scotland, with the view of paying off his debts and thereafter devoting his life to improving the hitherto neglected native Argentine cattle. About 1867 steps were taken to raise the standard of the scrub cattle of Texas, Colorado, and other North American States, with the result that for some twenty years the breeding of improved types of cattle was a great industry in the south-western and western States of the Union. But in course of time cattle ranges practically disappeared in North America. Thanks largely to Maclennan, as cattle ranges disappeared in the United States, improved breeds of cattle made their appearance in the Argentine. But for this the supply of sufficient meat for the Army in France and for home consumption would have been extremely difficult. In July the wholesale price of the best class of Argentine beef was 3½*d.* per lb., *i.e.* 1½*d.* less than in New South Wales. Maclennan thoroughly realised the kind of animals required to improve the descendants of the cattle originally introduced into South America by the Spaniards. He trusted more to make and performance than pedigree, and being extremely conscientious, he was trusted by the Argentine breeders, and so completely gained the respect and admiration of British stockmen and others he had dealings with that at a memorable gathering at Perth in 1914 Lord Lovat, in the name of his many friends, presented him with his portrait.

FEW Augusts of recent years have been so unsummer-like as the month which has just closed, and the weather conditions were almost continuously rainy and cool, whilst the winds have been stormy, amounting at times to the full force of a gale. During the latter half of the month cyclonic disturbances traversed Great Britain almost daily, the wind incessantly backing and veering through south and west. At South Kensington, the observing station of the Meteorological Office, the highest temperatures observed throughout the month were 77° on August 23 and 75° on August 7. On some days towards the close of the month the thermometer at the health resorts failed to touch 60°, even at Hastings, Falmouth, and Bournemouth. The *Times* of August 31 and September 3 gives an account of a dull and wet August. It states that the month had an excessive rainfall over the whole country, the rain measurements being almost as heavy as in 1912, the wettest August on record. In many parts of England and Ireland the aggregate rainfall for the month amounted to more than double, and at some places in the west to nearly three times, the average. At the headquarters of the British Rainfall Organisation in Camden Square the total of 3·99 in. was not so large as in the August of last year, but at Kew Observatory the total of 4·08 in. was larger than in any August since 1912, or, with that exception, since 1881. At Wandsworth Common the total of 4·66 in. was more than double the average, and was larger than anything recorded since 1912, although it was not quite so large as in the August of 1903. The highest temperatures are said to have occurred in Scotland and the north of England, where at the close of the first week the ther-

mometer exceeded 80°, registering 84° at Nairn. At Kew the highest temperature was 75°, and at Hampstead 73°. Temperature is said to have been much more favourable than in August, 1912, when the thermometer failed to rise above 70° at any but a few scattered places in England, and at many places in the northern and western districts it failed to exceed 65°.

Symons's Meteorological Magazine for August contains a short account of the unusually heavy and persistent rain in the south-east of England between July 29 and August 4. In London the rainfall for the six days amounted to 3·78 in. More than 7 in. fell at a number of places: at Canterbury (St. Thomas Hill) the measurement was 10·31 in.; at Maidstone 8·09 in.; at Kingston Rectory 7·51 in.; at Teynham, Kent, 7·32 in.; and at Margate 7·05 in. These amounts are in many cases said to have been quite unprecedented. In the three days, from July 30 to August 1, the rainfall measured 6·18 in. at Maidstone, 5·82 in. at Canterbury, and 5·58 in. at Meopham. A more detailed account is promised in "British Rainfall, 1917." In July the rainfall over the whole of the British Isles was only 69 per cent. of the average; in England and Wales it was 76 per cent. Correlations of the several meteorological elements are being studied with the view of securing long-period forecasts, and the magazine contains a short account of correlations between the temperature at South Orkneys and the rainfall in the Argentine Republic, by N. A. Hessling. With two years' interval between the temperature and the rainfall the correlation is negative, whilst with three and a half years' interval the correlation is positive. It is suggested that the negative correlation may be explained by the annual ice, and the positive correlation by ice which has broken away from the permanent ice-barrier, the greater thickness of this ice explaining the longer interval. Similar reasoning is followed for correlations between temperature at Stykkisholm in Iceland and Jacobshavn in Greenland and the rainfall at Albany, N.Y., with two years' interval; there are also similar correlations for Paris, Greenwich, and Ponta Delgada.

IN the *Times* for August 27 Dr. Andrade continues the discussion on the sound of gunfire introduced by Mr. Sleggs's letter (see NATURE for August 23, p. 513). Referring to the work of Prof. Mach and more recent writers, he remarks that "the sound produced by a high-velocity gun, as heard in front of the piece, is double, consisting of a sharp crack, which is very distressing to the ear, followed at an interval (which for the 60-pounder may be two or three seconds if the listener is in the line of fire) by a dull boom, which is the true sound of the firing of the piece. This boom is a much duller and heavier sound, which shakes buildings, but does not hurt the ear. The sharp crack is not produced by the gun directly, but by the shell during its flight, and then only if the initial velocity of the shell exceeds that of sound, as is the case with all modern guns. . . . The interval between the two sounds is greatest in the line of fire; as one walks to a flank it becomes less and less, until finally only one sound, that of the gun itself, is heard, the same sound that is heard behind the gun. The zone within which the double sound is heard is bounded by lines from the gun, making an angle of somewhere about 45°–65° on either side the line of fire, varying with the initial velocity of the shell and also with the angle of elevation at which it is fired." Dr. Andrade points out that this shell-wave accounts for the fact that for an observer some distance in front of the batteries taking part in a bombardment the noise is much more trying to the ear than for one an equal distance to the rear of the batteries, quite apart from the noise of the enemies' guns. Owing to the shell-wave being directed, and also originated, in the air well above such obstacles as trees and houses, it carries farther than the gun-wave, and is often the only sound heard of the enemies' guns, the true noise of the discharge of the piece being lost if the gun is far back behind the enemies' lines.

IN his paper on "Masks and Acting," published as No. 7 of Occasional Publications of the Classical Association, Dr. F. B. Jevons remarks that while of late years classical scholars, both of Oxford and Cambridge, have paid increasing attention to anthropology as well as to the classics, it is surprising how little discussion has been devoted to the possibility that there may be some connection between the use of masks in the performance of savage mysteries and in the performance of the Greek drama. Outside Europe masks and acting are part of the commemoration of the dead, and also form an element in the worship both of vegetation spirits and of theriomorphic spirits. A presumption is thus raised that similar rites were used in Greece, and that these three types of observances eventually gave rise to tragedy, comedy, and the satyric drama. This is corroborated by the mummers' plays of England and modern Greece, and if the conjecture be accepted, these mummers' plays spring from the same source as did Greek comedy, and, like it, inherit their masks and acting from prehistoric times.

THE Journal of the Gypsy Lore Society now appears (vol. viii., part 3) after unavoidable delay caused by the war. The chief contribution to this number is a paper on "English Gypsy Folk-tales and other Traditional Stories," collected by Mr. T. W. Thompson, who by long intercourse with branches of the tribe has acquired a remarkable familiarity with their manners and customs. Many gipsy folk-tales have already been collected by Campbell, Groome, Sampson, Leland, Hall, and others, and the material seemed to have been fully gathered. Mr. Thompson has now discovered some old gipsies who possess a hitherto unknown stock of traditions, and during six months he recorded no fewer than sixty märchen, drolls, and lying tales hitherto unknown. From the instalment of his collection now published he is perhaps inclined to over-estimate the value of this new material, many of the tales being little more than trivial anecdotes. But there is much of substantial value, such as the fine tragical story of "The Robber and the Housekeeper" and a gipsy version of "Jack and the Beanstalk." Mr. Thompson appeals to students of folk-tales for assistance in collecting parallels to the incidents with a view to the publication of the entire collection at a future time.

IN the *Veterinary Review* for August (vol. i., No. 3) Capt. Frank Chambers, A.V.C., states that evidence has been obtained that animal trypanosomiasis can be and is spread in tsetse-free areas by the agency of biting flies, of which the Tabanidæ are the worst offenders. This number also contains a further series of abstracts of papers, which is such a valuable feature of this journal.

AN address to nurses delivered by Dr. Mercier to the nursing staff of The Retreat at York in 1909 has been issued in booklet form ("The Ideal Nurse," The Mental Culture Enterprise, 329 High Holborn, W.C.1, price 1*s*. 3*d*. net.). While written primarily for the mental nurse, it contains a number of hints and suggestions which would be of value to any nurse, and these are presented to the reader in an attractive form.

THE *Brooklyn Museum Quarterly* for April, which has just reached us, contains a brief but interesting

account of the nesting habits of the Sooty albatross of South Georgia by Mr. R. C. Murphy. During a four months' stay in South Georgia Mr. Murphy found plenty of nests of these birds, though all but three were inaccessible, being placed on the ledges of unscalable cliffs, sometimes as much as 700 ft. up. In one nest which he examined he found a male brooding a downy chick, and succeeded in photographing both. The coloration of the head of the latter is conspicuously different from that of the adult, and recalls that of the Emperor penguin. This particular family was brought back, and is now mounted in the Brooklyn Museum. Judging from the photograph given of this group, it does not excel as an example of the taxidermist's art.

THE forty-eighth annual report of the trustees of the American Museum of Natural History for 1916 has just been issued. Beautifully illustrated and admirably compiled, it is certain to arouse considerable interest among those concerned with the management of museums all the world over. In spite of the war, we are glad to note, the trustees have decided to proceed with their scheme for the addition of a new wing, which is to be called the Court of Ocean Life, and it is to be "the most complete and beautiful museum unit in the world." It is to include a "Hall of Fishes," a great whale gallery, a gallery for the reptiles of the world, and above this a "Hall of Dinosaurs." The building is planned, in short, on the lines of the famous Oceanographic Museum at Monaco. Since, owing to the war, public funds are not available for this great work, the trustees have appealed to the generosity of the public, who, as usual, have responded promptly and liberally. But a sum of 400,000 dollars yet remains to be collected to complete the 1,000,000 dollars which must be raised to complete the work.

A BRIEF but most admirable memoir of the gorilla which died lately in the Dublin Zoological Gardens is given by Prof. G. H. Carpenter in the *Irish Naturalist* for August. This animal, a female, lived in the gardens three years and four months, the longest period through which a gorilla has survived in captivity in the United Kingdom. Though less interesting and friendly than most of the chimpanzees which have lived in Phœnix Park, "Empress" was always docile, but she resented any attempt at nursing or being carried about, even by her keeper. But she showed a great affection for a young male chimpanzee, which was her constant companion. For a brief space, while the chimpanzee was unwell, she displayed great anxiety, and tried to nurse him as though he were a sick child, pillowing his head on her body. During her games with "Charlie" she was in the habit of drumming with her fists on her breast, as a kind of challenge. She not only rarely lost her temper with him, but indeed showed towards him something like subservience, even giving up, without protest, food that he was greedy enough to covet. But she was always less active than her fellow-captive, and could never be induced to leave her cage with him for a ramble, though all kinds of inducements were held out to her to do so. The length of life in captivity attained by the Dublin specimen seems to have been exceeded only by the female which lived in the Zoological Gardens at Breslau nearly seven years. Three most excellent photographs add greatly to the value of this history.

AFTER five months' suspension, we are glad to receive the second number of the *Kew Bulletin* for this year. This number is mainly occupied by a careful revision of the difficult fungus genus Phomopsis, which has long been imperfectly known, and the present account, by Mr. W. B. Grove, which deals with the British species, will be of great value to mycologists, both in this country and in the United States. A second article, on "Tree Labels at Kew," gives a detailed description of the treatment of the descriptive card labels, by celluloid varnish, for the purpose of resisting exposure to weather and also of avoiding the use of glass.

IN his address on the social, educational, and scientific value of botanic gardens, delivered at the dedication of the laboratory building and plant-houses of the Brooklyn Botanic Garden on April 19, 1917, Prof. J. M. Coulter made some interesting remarks on fundamental and practical science, the two phases sometimes referred to as pure and applied science. With reference to the general impression that pure science holds no relation to public welfare, and that applied science serves our needs, Prof. Coulter points out that only by pure science is applied science kept alive and progress made possible. To neglect the former would be like wanting children and eliminating parents, or like some "practical" men who would praise the practical electric light and forget the unpractical, because unseen, power-house. To this power-house may be likened scientific research, which generates the energy we apply in developing what may be called the machinery of our civilisation.

IN a report on the work of the Imperial Institute presented to the new Executive Council, some account is given of the investigations that have been completed into the composition value and commercial prospects of a variety of raw materials derived from some twenty-four countries in the Overseas Empire. In Egypt flax-growing is being extended, and a sample of flax straw has been valued in Belfast at from 200*l.*–220*l.* per ton. In normal times such flax would be worth 60*l.* per ton. In Seychelles, ajowan, *Carum copticum,* and the mosquito plant are being cultivated with success as sources of antiseptic thymol, which used to be imported into this country from Germany. Another matter of interest relates to the important clove industry of Zanzibar and Pemba, whence last year a record crop of cloves was obtained. In recent years the trees have been attacked by a disease which could not be traced to any fungus or insect pest; and it has now been found, as a result of an examination at the Imperial Institute, that the soils in which the affected trees were growing have become acid and deficient in lime and phosphates, through neglect of proper cultivation, and appropriate remedial measures have been suggested for trial.

OF modern contributors to Italian scientific and general literature, probably few have shown so much versatility as Aldo Mieli. A list of Mieli's writings, dealing with the period 1906–16, has now been published (Florence: Libreria della Voce, 1917, pp. 64) Born at Leghorn on December 4, 1879, Mieli graduated at Pisa in chemistry in 1904. He afterwards studied under Ostwald, and assisted in the department of chemistry at the University of Rome, obtaining the rank of *privatdozent* in 1908. He acted as chief editor of the *Rivista scientifico-industriale* of Florence during part of the years 1907–9, and was also editor of the Italian section of the Belgian periodical, *Isis,* suspended at the outbreak of war. In addition, he edited the natural science section of the *Rivista per la storia critica delle scienze mediche e naturali,* as well as a series of "Classics of Science and Philosophy," published at Bari (Società tipografica editrice barese). He also wrote a large number of papers, as well as book reviews, for the leading Italian scientific journals, and a list of these is included in the pamphlet before

us. Among the subjects dealt with are chemistry, physics, history of science, including Roman and Greek history, politics, philosophy, and music.

METEOROLOGISTS and physicists who are interested in the subject of globular lightning will find two papers by Prof. Ignazio Galli, published by the Pontificia Accademia Romana dei Nuovi Lincei in 1916 and during the present year, of great value. The phenomena present themselves under such varied guise that some physicists are inclined to doubt altogether their actual existence, preferring to regard what is seen as the result of an optical illusion produced by the light of the discharge. Prof. Galli, in addition to an historical account of older references to the subject, going back to classical times, has collected from the appropriate scientific literature a large number of modern observations. These are well classified according to the various appearances presented and will form a very convenient source for comparison and reference. The writer of this note may, perhaps, be allowed to put on record an observation of his own. Some years ago, when driving with a friend, he was overtaken by a violent thunderstorm accompanied by torrents of rain. When the storm was at its worst a vivid flash of lightning was immediately followed by a terrific clap of thunder; on looking up against the driving rain each of us saw, on a small hill about half a mile in advance, a luminous globe the angular diameter of which was rather less than that of the moon, and the colour of which was that of the positive glow in a carbon dioxide vacuum tube. This persisted for nearly five seconds and then suddenly disappeared.

MR. LEO WALLERSTEIN is the author of an interesting and comprehensive paper entitled "Enzymes in the Fermentation Industries" in the Journal of the Franklin Institute for May and June. A general outline is given of the wide field over which enzyme activity ranges, from the decomposition of urea by urease to the coagulation of the blood by thrombase on exposure to air. Stress is laid on the conditions characteristic of optimum enzyme activity, viz. the specificity of enzymes, the importance of temperature and reaction of the solutions in which they act, and their colloidal nature. It is pointed out that enzymes, although of importance industrially mainly as decomposing agents, are naturally of equal importance synthetically, as they serve to build up the tissues of the animal body and of plants. Mr. Wallerstein gives a detailed account of the brewing process from the point of view of the enzymes concerned. In the malting of the barley grain the reserve food material of the endosperm is rendered available by the oxydase, amylase, protease, etc., secreted by the embryo. In the mash-tun the starch is degraded to maltose and dextrin by the action of the amylase, whilst the proteases effect changes in the proteins present. Finally, in the fermentation of the sterile wort with yeast the chief enzyme action is the decomposition of the sugar into alcohol and carbon dioxide by means of zymase. It was discovered by the author that beer can be made chill-proof (when kept on ice beer becomes cloudy, owing to separation of protein matter) by addition of a very small proportion of pepsin to the sterilised wort. The power of the yeast cell when provided with sugar, ammonium sulphate, and inorganic salts to synthesise albumen has been employed in Germany, where large quantities of yeast are so prepared and used as a cattle food.

IT is more than seven years since the date of the last disastrous flood which inundated Paris and left a record in height surpassing anything since the year 1658. Although the intervals between the graver visitations of this kind seem to be increasing, yet the Parisians have not failed to recognise the inevitability of their recurrence and the necessity of preparation for them. Shortly after the floods of January, 1910, a commission was appointed for the purpose, under the presidency of the late M. Picard, and a few months later a report was issued containing its recommendations. Some of these have already been carried into effect, but the more important are still under consideration, partly on account of their magnitude and cost, and partly on account of the war. In January last year the French Government brought forward legislative proposals, which included the widening of La Monnaie channel in Paris itself and the deepening of the Seine between Suresnes and Bougival, at a total estimated cost of 67,346,000 francs, or nearly 2,700,000*l*. A deviation of the Marne, by means of a canal from Annet to Epinay, though recommended by the commission, is not regarded at the moment as a feasible proposition. It is calculated that the works proposed to be carried out will effect a lowering in flood height of rather less than half a metre, say 18 in. The period required for their execution is at least seven years. Operations will involve the moving of a section of the Paris-Orleans Railway and the building of a new quay wall opposite the Cathedral of Notre Dame. We are indebted for these particulars to an article in the *Engineer* of July 6.

THE *Times Engineering Supplement* for August 31 contains an account of the Australian Transcontinental Railway, which is now practically completed. This railway runs from west to east, and for the first time puts Western Australia in direct railway communication with the other States in the Commonwealth. It will reduce by two or three days the time required by passengers and mails to travel between Great Britain and the eastern States of Australia. Among other advantages, it will tap the resources of a stretch of country having great productive possibilities, and it also possesses strategic importance. The line runs from Kalgoorlie, in Western Australia, to Port Augusta, in South Australia—a distance of about 1051 miles, and its course is roughly parallel to the coast of the Great Australian Bight, but always well away from it. The highest elevation attained is 1354 ft. The standard gauge of 4 ft. 8½ in. is adopted. The railway is designed for high-speed running, and when the ballasting is complete the journey between Kalgoorlie and Port Augusta should be made in about twenty-four hours.

UNTIL quite recently the semi-Diesel, or hot-bulb, type of oil engine for marine purposes was considered to be suitable for comparatively small powers per cylinder. Recent modifications in design have brought this type into favour for powers up to 130 brake-horse-power per cylinder. The Beardmore engine—described in *Engineering* for August 24—has four cylinders, each 11 in. diameter by 15-in. stroke; working on the two-stroke cycle, it develops 160 brake-horse-power at 280 revs. per min. It is particularly suited to consume fuels ranging from 0·8 to 0·9 specific gravity, but can be adjusted to use either slightly lighter or heavier oils. The low speed of revolution is conducive to high propeller efficiency. The engine is directly reversible by means of compressed air, and requires no disconnecting clutch between the engine and the propeller. For a typical British coaster, 75 ft. long, the 160 brake-horse-power engine weighs 145 cwt.; the weight of the complete installation, including fuel tanks, floor plates, pipes, etc., is 14 tons, and the engine-room bulkheads are 15 ft. apart. One thousand gallons of fuel can be carried, and this quantity gives the vessel an acting radius of 750 nautical miles.

OUR ASTRONOMICAL COLUMN.

SOLAR RADIATION AND TERRESTRIAL METEOROLOGY.—In view of the evidence obtained by Abbot as to short-period changes in the intensity of solar radiation, Mr. H. Helm Clayton, of the Argentine Meteorological Service, has investigated the possible coincidence of these variations with atmospheric changes on the earth (Smithsonian Miscellaneous Collections, vol. lxviii., No. 3). Comparison was first made with temperature observations at Pilar, in Central Argentina, and afterwards, as regards both temperature and pressure, at a number of widely distributed stations. The pressure correlation was found to be the reverse of that of the temperature. In the tropical regions the temperature rises and falls in unison with the changes of solar radiation, but follows the solar changes by about two days; following a rise of temperature, the pressure falls, reaching a minimum between the second and third day after the solar change. On the succeeding day the pressure attains a maximum in the temperate region and the temperature a minimum. Four to five days after the solar changes there is a minimum of pressure in the Arctic Circle near the 60th parallel in both hemispheres, and a maximum of temperature in the oceanic centres of low pressure like that near Iceland. These results are interpreted as indicating a transference of air from the tropics to high latitudes, probably in the upper layers. Analysis of the solar variation suggests a period of about twenty-two days, which was also shown by the fluctuations of temperature at Buenos Aires during the same period. Continued observations of solar radiation are regarded as being of great importance for meteorology.

PROPER MOTION OF THE GREAT ANDROMEDA NEBULA.—Prof. Barnard has recently given an account of his attempts to detect proper motion of the great nebula in Andromeda (*Astronomical Journal*, vol. xxx., No. 20). The nucleus of the nebula is about 2″ to 3″ in diameter, but it is so strongly condensed that under good conditions it can be bisected with almost the same accuracy as the comparison stars. In 1898, in the hope of ultimately detecting motion of the nebula, Prof. Barnard began a series of measurements with respect to three small stars which seemed to have no connection with the nebula. The observations were repeated in 1909, and again in 1915–16, but notwithstanding the lapse of eighteen years, no displacement could be detected. Previous measurements by other observers are somewhat discordant, but appear to show that no considerable motion has occurred during the past eighty years. The individual measures by Prof. Barnard show that the parallax must be beyond the reach of ordinary micrometer work. In the course of these observations the place of the nova of 1885 was carefully examined, but nothing was seen in this position.

THE LUNAR ECLIPSE OF JULY 4.—During the total phase of the eclipse of the moon on July 4–5, 1917, it was remarked by several observers that the brightness of the disc was sensibly greater near the limb than towards the centre. It has been suggested by M. A. Nodon that this appearance may possibly indicate a feeble luminosity of the surface of the moon (*L'Astronomie*, August). An experiment which appears to support this view is described by M. Nodon. A brass ball about 10 cm. in diameter was placed in a dark box, of which only one side was open, and was viewed in a feeble light; the appearance observed was that of a disc brightest at the centre. On the other hand, in the case of a sphere which was uniformly coated with a slightly phosphorescent substance, the luminosity was greater at the edges than at the centre. Phosphorescence of some of the materials composing the lunar surface is accordingly suggested as a possible explanation of the distribution of luminosity observed during the eclipse.

THE MODERN RANGE-FINDER.

THE War Office has published a pamphlet on the modern range-finder, written by Prof. Cheshire, and, as is to be expected from an author of such technical knowledge, it is a clear and thorough exposition of a difficult and attractive subject When it is considered that all that a range-finder has to do is to enable the observer to utilise the angle of convergence upon a distant object of the widely spaced eyes of the instrument in order to find the distance of the object the problem of range-finding may appear to be very simple, and so in principle it is. This is not the difficulty. The real difficulty is to make an instrument which shall be portable, handy, and quick in use, and also shall attain the ultimate possible limit of accuracy. That which is not only attainable, but attained every day is something so perfect as to exceed the utmost that an inventor might have dared to hope for. Some form of reflecting device is needed at each end to bring the two sets of optical beams together into a single eyepiece. Any structure that supports the mirrors or prisms is liable to bend under its own weight or on account of differential heating. Simple reflectors at the ends would double any such angular displacement, and the kind of accuracy required would be unattainable. Double-reflection prisms, however, may be tilted without affecting the apparent direction of the object, as may be noticed when using the ordinary camera lucida. However, such oblique reflection would require prisms of inconvenient size; accordingly pentagonal prisms are used, which, however, require to have their reflecting faces silvered, as they are within the critical angle. As these prisms turn the beam through an invariable angle, slight flexure such as is here contemplated does not matter. The prismatic devices near the eyepiece designed to bring the two beams in two parts of the field into view together and into perfect alignment, where the object is at a very great distance, must not only do this, but the line of demarcation between the fields should be sharp throughout its extent. This is essential to accuracy. These fields may both appear erect, or one may appear inverted either laterally or vertically. Where there is convergence of the beams the alignment is disturbed, and the optical means by which it is corrected, as by a sliding prism, are connected up with a scale, so that the distance may be read directly. In the Barr and Stroud range-finder, which is more particularly described and illustrated, this scale is seen by the other eye through a separate eyepiece. It is satisfactory to find that in the essential of sharpness of the line of demarcation the Barr and Stroud instrument is superior to two German forms.

It is quite impossible in the limits of space here available even to indicate the nature of the highly ingenious three-dimension reflecting devices which serve to bring the two converging beams into sharply separated parts of the field, and in the Barr and Stroud instrument at the same time to throw them up at an angle of 60°, so that the observer lying on the ground or in other comfortable position may look down at a convenient angle instead of wearing out his neck by looking horizontally. In one form of instrument made by Zeiss the telescopic magnification of the two beams is different, so that the images seen in juxtaposition are of different

dimensions. In that case there is no necessity to employ sliding prisms and scale, or equivalent, as the part of the field where the coincidence occurs depends upon the distance of the object, and thus a scale of distance at the focus of the eyepiece is all that is needed. Of all methods of using the angle of parallax to find the distance, the most attractive is one proposed by a workman in the Zeiss works, and which, after much difficulty in its elaboration had been overcome, was shown to the present writer by the late Dr. Czapski at the Paris Exhibition of 1900. In this instrument the right and left beams are received by the right and left eyes respectively of the observer, and owing to the distance between the two beams entering the instrument a superstereoscopic view of the object is seen. At the same time each eye sees in the field of view a scale of distance, but the two scales are differently ruled in such manner that the eyes combine them stereoscopically and the scale of distance appears projected away into space. It was fascinating to sweep this scale past more or less distant buildings and see the divisions of the distance scale pass behind or in front of the different objects, or to look up the Eiffel Tower and tickle the members of the framework with the nearer divisions. For the purpose of aircraft range-finding this method, on account of its speed, would appear to have great advantages, and even if it does not equal in accuracy the more deliberate methods of other range-finders, this cannot be of consequence when the range is changing at so high a rate. Some discussion of this type of range-finder by Prof. Cheshire would have been very valuable. The number of the German patent is 82,571, and the date July, 1895. A description is to be found in the second volume of the collected papers of Ernst Abbe, published by Gustav Fischer in the year 1906.

Returning now to the question of the limitation of accuracy, the figures quoted as having been obtained on a Barr and Stroud instrument are important and surprising. The base of the instrument was three yards, but the diameter of the object glasses is not stated. Using an optically prepared artificial object, the accuracy of setting obtained by an experienced and highly skilled observer was such that the mean error was about one-fifth of a second of arc, *i.e.* an angle with a circular measure of one divided by a million. When it is remembered that the defining power of a telescope as measured by the diameter of the star image is about 4·5 seconds of arc divided by the aperture in inches, this is equivalent to saying that the aligning power of this range-finder is equal to the separating power of a perfect telescope of about 22-in. aperture, and that irrespective of the length of its base. Or if, as is likely, the aperture is about 2 in., the aligning power is more than ten times the possible separating power. Similarly, on multiplying by the magnifying power, it appears that the aligning power of the unaided eye is in the neighbourhood of 3 seconds of arc, which is still more surprising when it is remembered that the separating power is certainly insufficient to divide 60 seconds. It would be interesting to ascertain what is the aiming power of a good billiard player when, for instance, the object ball is near the striking ball and far from the pocket, but when, nevertheless, with this coefficient against him, he can time after time drive the ball clean into the pocket. That, whatever it is, must be very great, but it must be exceeded by the aligning power of the eye in the comfortable use of a good range-finder. Figures such as are here given must be realised before the skill and marvellous attainment of the designer and constructor of the modern range-finder can be appreciated. There is much more in this pamphlet that it would be interesting to follow if space were available.

C. V. BOYS.

THE RELATIONS OF MATHEMATICS TO THE NATURAL SCIENCES.

BY a happy coincidence, the addresses of the retiring presidents of two leading mathematical societies, delivered almost simultaneously, follow similar lines, although from somewhat different angles of view, and are of unusual interest for the man of science whose surmises regarding natural phenomena receive their ultimate justification from mathematical reasoning. Such a man has had cause more and more in recent years to deplore the divorce between the more striking mathematical developments of the present time and those which are urgently necessary as an inspiration to progress in his own work. For, as the two presidents point out, the insistent call for help to the pure mathematician has now begun, though perhaps reluctantly, to take shape even from the biological sciences.

Prof. E. W. Brown, in his address to the twenty-third annual meeting of the American Mathematical Society, selected the subject the title of which we have borrowed, and indicated somewhat precisely the types of work really needed from the pure mathematician in this regard, and their capacity for furnishing a fruitful field of research of great interest to any willing investigator. Sir Joseph Larmor, in his address to the London Mathematical Society in November, 1916, limited his detailed remarks more especially to the scope and limitations of the harmonic analysis associated with the name of Fourier. The problems connected with periodic phenomena were evidently predominant also in the mind of Prof. Brown during the preparation of his address, and the necessity for a Fourier type of treatment of such problems renders the two addresses complementary in the regions in which they are not closely parallel.

We may turn, in the first place, to the more general point of view present in both addresses, and outlined in greater detail in Prof. Brown's. Pure mathematics is a science or an art which is self-contained, and requires for its development no external inspiration. Applied mathematics is an aid towards the develonment of the natural sciences, and in fact of all investigations which depend on deduction from exact statements. Such statements are, of course, founded not on axioms, but on physical laws which sum up the results of series of experiments, and these laws no longer, as in the past, serve to suggest suitable axioms and profitable lines of development of pure mathematics as an art. So large a body of doctrine, in fact, has pure mathematics become that isolation is marked among its many branches, and one mind can no longer be fully conversant with each of them. The task of our presidents, in attempting a fusion between pure and applied mathematics, becomes more and more difficult.

Prof. Brown points out one fundamental difficulty in the lack of standardisation of mathematical symbols. In spite of the fixed character of the underlying principles, such a symbol as (1) may still denote a number, operator, group, function, axiom, or convention, and any of these may have special limitations for the purpose in view. He suggests that the task of a reader of several members should be facilitated by extending the principle now used in the case of the special type adopted to represent vectors. Such a prearranged system would have special advantages in the subsequent compilation of any future mathematical encyclopædia. Prof. Brown pleads also for an extension of the growing practice, even at the cost of artistic appearance, of printing a summary at the end of each published paper.

These and other purely mechanical aids to the

student of science are, of course, only side-issues, and do not touch the main problem of evoking, on the part of the pure mathematician, an interest in the applications. The pure mathematician has not the leisure necessary for familiarity with the history and essentials of a proposed problem, but he could assist by turning the thoughts of his better students into such a direction. When he does become interested in an application, he usually studies only the mathematical methods tried more crudely by others. His interest, in fact, lies more in the logic of the matter than in any co-ordination of new phenomena which may be obtained. Yet at the same time he must not be blamed, for the physicist and engineer rarely present their problems in such a form that the mathematician can even begin to seek a solution. He does not know what approximations he may make and yet retain a solution of value. The proper function of a treatise on applied mathematics is to give strict formulations of problems and an account also of the principles which underlie good physical approximations. The applied mathematician who can fulfil this function, and intervene between the mathematician and the experimenter, is now lamentably rare. The temptation to go to one of the extremes is too strong under the present system, though Prof. Brown suggests various ways in which such men could be encouraged to steer the middle course.

The fundamental subjects which, from the present point of view, demand systematic examination, and, more especially, simple exposition from the mathematician, are: the numerical solution of classes of differential equations, symbolic forms adapted for rapid numerical calculation, reduction of a series of numbers to the best formula, and Fourier and other representations of periodic phenomena. Under this last heading a considerable contribution is made by Sir Joseph Larmor's address, which cannot in this respect be noticed at all adequately in our present space. But it is readily accessible, and this fact somewhat precludes the necessity. In so far as it is general the views expressed are essentially similar to those outlined above, and it includes, moreover, an instructive account of the history and present state of the society, with suggestions towards its future adaptation to changing conditions.

In his critical analysis of the Fourier harmonic method Sir Joseph sketches the history of its development, and afterwards points to an insistent question: What is to be done with the accumulated observational data such as are being piled up by meteorologists and statisticians, and to what extent should they be continued? Such questions are of the essence of pure mathematics and not strictly of its technical application. It is a curious fact that progress in such directions was practically stopped by difficulties in running the Kelvin integrating machine. Sir Joseph Larmor makes a powerful appeal to the pure mathematician to revive his former interest in such problems, and cites the work of Schuster as a striking illustration of the success which could be obtained by an organised attack. We may cite, as another illustration, Sir Joseph's own discussion of some of the problems of radiation, which forms the remainder of his address, for it presents many sides of the question which have been only too imperfectly considered by those who work with any aspect of the Fourier analysis.

We can only repeat that it is a fortunate event, and perhaps a sign of the times, that the presidents of the two leading mathematical societies in the English-speaking world should have chosen the same ground so closely, and independently expressed concordant opinions even in points of detail. This fact must surely stimulate workers to an interest in these questions, the elucidation of which, even if only partial, would be a fundamental gain to the whole range of work in the province of natural science.

J. W. NICHOLSON.

PRECISE LEVELLING IN THE WEST OF ENGLAND.[1]

THIS recently published Professional Paper of the Ordnance Survey gives an interesting account of the revision of a line of precise levelling which had been carried out under the direction of a committee of the British Association in the years 1837 and 1838. The line was run from Axmouth, on the coast of the English Channel, to three points on the southern coast of the Bristol Channel, and the terminal points were marked with metal bolts "to afford a basis for a comparison with the position of the lines then determined, at present, and at any future period." When the revision of the primary levelling network of Great Britain was undertaken the revision of this particular line was included in order to see whether there was any indication of earth movement, and in the course of the last three years it has been found practicable to carry out this work by the reserve levelling staff which has to be maintained at Southampton. The earlier levelling was carried out by Mr. T. G. Bunt, and full details are given by Dr. W. Whewell and him in the report of the British Association for 1838.

He used a level by Simms which had a telescope 14 in. in length and a magnification of 26. The bubble is said to have been affected by a movement of 1/100,000 in. of either end. The staff used was at first of brass, but this being found unsatisfactory, it was replaced by one of seasoned oak 9 ft. long and having scales on both sides. Nothing is stated about the verification of the staff divisions. The staff was read with the aid of a vane or target, of which the position was read by a vernier to 1/500 ft., and it is stated that the average error of a single reading was 1/250 in. Lines were levelled in both directions from beginning to end, then from end to beginning, and the discrepancies found are recorded. Mr. Bunt mentions a systematic error which he experienced, viz. that "the heights of all points came out less by the levels returning than by the levels going," and from Portishead to Axmouth, a distance of seventy-four miles, the discrepancy between forward and backward levelling was 1·029 ft. The old levelling books are not now to be found, so that the comparison with modern work could only be made over the distances between Axmouth, Axmouth Church, Stolford, and Perry Farm, where the old marks are still existing.

The discrepancy between the older and the new levelling from Axmouth to Perry Farm, a distance of fifty-seven miles, is but 0·92 in., though at Stolford, fifty-five miles, it reached 2·11 in. The amount of the accidental and systematic errors of Bunt's levelling computed by the formulæ adopted by the International Geodetic Commission is 1·0 mm. and 0·9 mm. per kilometre respectively, against the limits of 1 mm. and 0·2 mm. per kilometre, as laid down by international agreement for precise levelling.

The conclusion arrived at is that there is no evidence of any change in the relative levels of the marks near the shores of the English Channel and the Bristol Channel.

The Ordnance Survey levelling was executed with a Zeiss No. 3 pattern 14-in. level with a parallel plate object-glass micrometer, and invar levelling staves. The operation is one of much interest as affording a comparison between the best class of levelling work in this country at the two periods.

H. G. L.

[1] Report on the Re-levelling in 1915–17 of a Line from the English Channel to the Bristol Channel. Ordnance Survey Professional Papers. New Series, No. 4, 1917. Price 6d.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

THE second annual report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1916–17 was published last week (Cd. 8718; price 3*d*. net). It consists of an introductory statement by Lord Curzon, as Lord President of the Privy Council, the report of the Advisory Council, signed by Sir William McCormick and Sir Frank Heath, and appendices giving Orders in Council, terms of the Imperial Trust, documents relating to research associations, and names of members of committees attached to the Department of Scientific and Industrial Research. Lord Curzon points out in his introduction that the foundation of the department led to the creation of the Imperial Trust for the encouragement of scientific and industrial research.

The trust holds on behalf of the department the sum of one million sterling which Parliament has voted for the purposes of the department. The negotiations of the Advisory Council with the leading manufacturers in the various industries showed that it would not be possible to develop systematic research on a large scale unless the Government were in the position to assist financially over an agreed period of years. These considerations led the Government to place a fund at the disposal of the Privy Council Committee to be spent over a period of five or six years afforded the best means of dealing with the problem. During the past year negotiations have been concluded with the Royal Society for the transfer of the property of the National Physical Laboratory, together with the responsibility for its maintenance and development, to the Department of Scientific and Industrial Research. The scientific management of the laboratory will remain in the hands of the Executive Committee under the chairmanship of Lord Rayleigh, a member of the Advisory Council.

The committee reported last year that grants had been approved to a number of individual students and research workers for the year 1916–17 to an amount not exceeding 6000*l*. The amount actually expended under this head, however, was not more than 3550*l*. upon thirty-six workers. Throughout the work has suffered in amount owing to the war, and the committee was unable to expend more than 14,524*l*. out of the 40,000*l*. placed at its disposal by Parliament for the financial year 1916–17. During the current year a sum of 38,050*l*. was taken in the estimates, in addition to the fund of a million referred to already. The annual vote is intended to cover (*a*) the cost of those researches which will not be undertaken by the proposed research associations; (*b*) the grants to individual research workers, both students and others; and (*c*) the cost of administration.

The second annual report of the Advisory Council records the considerable progress made during the past year, and some of the matters referred to in it are summarised below.

In our report of last year, covering the period from July 28, 1915, to July 31, 1916, we attempted to describe the nature of the problems by which we were faced, and the conditions which appeared to us necessary for their solution. We discussed the vital need of research at the universities, especially in pure science, and the urgency of prompt measures for increasing the number of their students. We referred to the beginnings of association among manufacturers, and expressed our belief in co-operation between capital, management, science, and labour, as the best means of financing and directing the extended laboratory investigations and the large-scale experimentation required for industrial research. Above all, we emphasised the necessity for patient effort, cautious preparation, and co-ordinated attack upon the problem from all sides.

The experience of another year of work has confirmed our first estimate of the position. We have made progress. The establishment in December last of a separate Department of State entrusted with the organisation of scientific and industrial research has brought encouragement to our efforts and the necessary financial support.

We have addressed ourselves during this year in the main to the organisation of industrial research, first, because we felt the paramount importance of arousing and securing the interest of manufacturers in the application of science to industry, and, secondly, because the influence of the war has created in industry an atmosphere conducive to the growth of new ideas, whereas it has unfortunately made the prosecution of work in pure science and in its organisation a matter of extreme difficulty.

THE MILLION FUND FOR TRADE RESEARCH ASSOCIATIONS.

The one question of policy, to which throughout the year we have continuously devoted our attention, is the working out, with all the care and advice we have been able to command, of the policy of co-operative industrial research foreshadowed in our last report. Lord Crewe, who was at that time Lord President of the Privy Council, received a deputation of the Board of Scientific Societies on December 1 last, at which he outlined the policy of the Government in regard to industrial research. He announced their intention to ask Parliament to place a large fund—a million sterling—at the disposal of the department to enable it to co-operate with the industries of the country in the foundation and maintenance of approved associations for research during the next five years or so. After these initial years it is expected that the larger industries, at any rate, will be able and willing to carry on the work of the associations without assistance. The intention of the Government is to make a contribution to the assured income of such associations from the subscriptions of their members, varying in amount according to circumstances, and with a normal maximum of pound for pound, though in very exceptional cases this limit may be exceeded. Lord Crewe also announced that the Board of Inland Revenue would be prepared to instruct surveyors of taxes to allow as a working expense for income-tax purposes the contributions by traders to industrial associations formed for the purpose of scientific research for the benefit of the various trades. The allowance would be subject to certain conditions; that is to say, the association must be under Government supervision and the trader's contribution must be "an out and out payment, made from his trade profits and giving him no proprietary interest in the property of the association." Since this decision includes war profits and excess profits taxes, it offers a considerable inducement to firms affected by these taxes to act promptly.

RESEARCH ASSOCIATION FOR COTTON.

Substantial progress has already been made towards the establishment of a National Research Association by the great staple industry of cotton.

In view of the establishment of the Cotton Committee we have postponed the consideration of several applications for aid to researches bearing on the cotton industry, some of considerable importance and interest. But in one case we have taken immediate action of an interim kind, because there was a risk that useful research work actually in progress might be interrupted. With the approval of the Secretary of State for the Colonies, we have asked the Government of

the Island of St. Vincent to second one of their officers, who has been making an investigation into sea island cotton, for work under Sir Francis Watts, the Imperial Commissioner for Agriculture in the West Indies. We have offered the Commissioner a grant of money to meet the cost of labour and necessary apparatus, and we have offered to pay the research worker an adequate salary on a rising scale. We hope that this arrangement may enable the new Research Association to take over the investigation in due course. Incidentally we shall have put a research which was in danger of coming to an end upon a more satisfactory basis.

Associations in Prospect.

We are glad to report that the woollen and worsted manufacturers of Great Britain have already appointed a Provisional Committee to draft the constitution of a Research Association. The Irish flax spinners and weavers have decided to take the same step; the textile industries are therefore well to the fore. The Scottish shale oil industry and the photographic manufacturers have decided to establish associations immediately, the electrical engineering firms and the British Society of Aircraft Constructors, in conjunction with the Aeronautical Society, have the matter under consideration, the Scottish shipbuilding and steel industries are moving, and we have hopes that it may be possible to establish an association for research into the non-ferrous alloys in the near future. We understand that the British iron puddlers and the Diesel engine manufacturers have independently established research organisations for the benefit of their respective industries. The coal-mining industry is interested, but it will necessarily take time to organise this huge industry on a national basis. Several other industries, among them the pianoforte manufacturers, the master printers, and the cocoa industry, have approached us. But there is a number of industries which for one reason or another are not so circumstanced that their firms are able to combine in this manner. In some cases the leading firms realise to the full the value of science and of a combined attack, but they cannot as yet carry the industry with them. This is the position, for instance, of the papermakers, who are urging us to establish a State laboratory to the initial and maintenance cost of which they are anxious to contribute.

Other Cases.

In other cases the industry may be prosperous and the leading firms possessed of what they believe to be valuable and exclusive information, which they fear might be endangered by co-operative research. We have remarked that those industries which call for the most complex organisation and are most in need of scientific guidance, if they are to meet modern conditions successfully, are for the most part those in which the smallest progress has been made towards research on a co-operative basis. We refer to that large group of what may be called the chemical industries. At one end of this group we find a growing movement towards financial combination, *e.g.* among the highly developed heavy chemical and allied industries. Financial combines or fusions of scientific industries on the scale we are witnessing will certainly render co-operation for research alone less attractive, if not unnecessary. At the other end of the scale are industries, like those of pottery and glass, which have been driven by adversity to seek the aid of science, and have only been able to meet the cost by operating together. Between the two extremes is a large number of industries, some of them wealthy, which appear to be uncertain in which direction to move, and would probably prefer to move in neither.

Researches Unsuited for Co-operative Action.

There will remain, however, important fields for industrial research which we can never hope to cover by means of research associations. Research into fuel is one of these. Every home in the land, as well as almost every industry, is directly concerned in the economy of fuel, and for that reason it is simpler and more just that all should contribute through the taxes to the cost of the research. The Committee of Council have accordingly established the Fuel Research Board as a part of the department. Similarly, we think the argument for a national board of research in timber will prove overwhelming; in both cases, however, we may hope to receive assistance, if not contributions, from some of the industries more immediately interested. The researches we are conducting through the British Fire Prevention Committee and the Concrete Institute respectively into the fire-resisting properties and into the general physical properties of different kinds of concrete, are also cases which call for national action. We have been assured that the same considerations hold good for the scientific problems underlying illuminating engineering and cold storage.

The National Physical Laboratory.

There is still another class of scientific problems of great importance to industry, not susceptible of treatment by associations for research. We refer to the determination of constants and standards, whether physical, chemical, or bacteriological, and the accurate testing of manufactured products in the interest both of manufacturer and consumer. The range and importance of this work and of the research which it entails are certain to grow rapidly in the future. The experience of other countries goes to show that it is work which the State must itself undertake, or at least control, if it is to be adequately served. We welcome accordingly the arrangement recently made by the Committee of Council with the Royal Society under which the department will become financially responsible for the maintenance of the National Physical Laboratory.

Three Methods of Financing Research.

It will be noticed, from what we have said above, that there seems to be room in the industrial world for three methods of financing research. There is research which the individual firm finds it remunerative to undertake at its own expense. Secondly, there is research which is financed on a co-operative basis; and lastly, there is research which must be financed by the State if it is to be done at all.

Is any distinction in kind to be drawn between these three classes of research which would justify this difference of treatment? If there is, and if it can be clearly stated, it should greatly assist the sound administration of public funds and be a useful guide to our own policy. We suggest that the distinction is to be sought in the probable nature of the results to be obtained from an investigation. If the research is one which a single firm can finance and which, if successful, will yield results that a single firm can exploit to the full, there is no case in normal circumstances either for co-operation with other firms or for assistance from the State. The more powerful the firm and the greater the variety of its activities, the more far-reaching will be the nature of the research it will be justified in undertaking. But as we pointed out in our last report, British manufacturing firms are not as a rule at the same time both large and complex. In the great cotton industry, where some of the firms have capital funds to be reckoned in millions, the organisation is "horizontal," not "vertical," and manufacturing success has been obtained by specialisation in a narrow range of processes. Far-

reaching scientific investigations which are likely to affect several sections of the industry are accordingly more suitable for co-operative than for single-handed attack. There will still be ample room for private research by individual firms on the lines of their own special work. Indeed, they may be expected to gather many suggestions for this from the results of the co-operative investigations.

On the other hand, the German chemical industry with its powerful firms engaged in handling the primary raw materials through all their intermediate stages up to the manifold but closely related final products, explosives, dyes, essences, drugs, antiseptics, would not be suited for co-operative research, though it may be prepared to go far in the direction of financial fusion—a mere continuation of the previous line of development.

If, as in this country, conditions are in many respects specially favourable to co-operation in the conduct of research, the State is, we think, justified in encouraging development along these lines by means of monetary and other assistance. We find the justification for our proposals for research associations in these considerations. But when the firms have done all that it will pay them to do in the way of both private and co-operative research, there still remain lines of investigation which will either be sufficiently fundamental to affect a range of interests wider than any single trade, however large, or else they will clearly have a direct bearing on the health, the well-being, or the safety of the whole population. The two types are not mutually exclusive, but research of either kind falls, we think, into the third class, and must be undertaken by the State itself.

Glass, Optical and Other.

We indicated last year, and the public have learnt to recognise the fact from constant reference to it, that the study of glass in many of its forms is one of serious importance for the national safety. For a short period there was grave anxiety, now happily removed, but we have not relaxed our efforts to deal with this many-sided industry in as comprehensive a manner as possible. The important research at the National Physical Laboratory, carried on at the cost of the department since 1915, has dealt with the fundamental problems of optical glass manufacture. Attention during the past year has been concentrated on the question of refractories. The superintendent of the metallurgical department reports that "important and encouraging results were obtained, both with pots made of the same material throughout and with others in which a more expensive and highly refractory material was employed as a lining only. Further progress was also made with investigations into methods of stirring and of melting which shall protect the glass from furnace gases and other sources of contamination in such a way as to leave the molten material freely accessible to stirring and other manipulation. The development of the electric furnace, particularly for the purpose of burning refractories at very high temperatures, proceeded satisfactorily. A new type of resistance furnace was evolved. Heat is generated by contact resistance between specially shaped graphite parts, and an endeavour is being made to substitute pressed carbon similar to that used in arc-lamp electrodes, as the latter can be obtained in this country."[1] While the National Physical Laboratory has been dealing with the fundamental problems of manufacture, Prof. Jackson has been investigating the composition of certain optical glasses for the department with the assistance of the Glass Research Committee of the Institute of Chemistry. He has succeeded in defining the composition of the bath mixtures necessary for the production of several glasses hitherto manufactured exclusively in Jena, including the famous fluor-crown glass. He has also discovered three completely new glasses with properties hitherto unobtainable. His work upon laboratory and other glasses during the past year has been chiefly devoted to assisting the manufacturers to perfect their processes and to remove difficulties which have arisen in the factories. Prof. Jackson's intimate acquaintance with manufacturing conditions has been of the greatest value for this purpose, and has, we are glad to learn, completely won the confidence of the makers. The dangerous position which existed when this council was first established having now been removed, thanks to the energy and initiative of the Institute of Chemistry, their Research Committee is now free to give its attention to other less urgent but not less important problems.

An investigation into abrasives and polishing powders, primarily in relation to their use in the grinding and polishing of glass, is about to be started under the direction of a committee of the department, and the Standing Committee on Glass and Optical Instruments has conducted, or is conducting, a number of inquiries with the view of ascertaining whether further research is required on the following subjects:—The annealing of glass; anti-glare glasses; the testing of, and the formulation of standards for, laboratory glassware; the permissible variations in the optical properties of glasses used by optical instrument-makers; improvements in refractometry; the silvering of glass surfaces; the standardisation of parts of optical instruments; the supplies of fluorite and of Iceland spar; and the plastic properties of materials. In some of these inquiries the department has already been able to give some assistance to the Optical and Glassware Department of the Ministry of Munitions and to the industries concerned.

The Research Institute for Glass at the University of Sheffield, in contemplation when we reported last year,[2] has now been established with the assistance of grants from this department and from two associations of glass manufacturers. The buildings have been erected and equipped on a larger scale than we then anticipated under an arrangement made by the Ministry of Munitions in consultation with the Committee of Council. Progress has already been made with several systematic investigations on glass problems and the results of one of them, concerned with the influence of small amounts of chlorides and sulphates in producing opalescence in glass, have appeared in the Journal of the Society of Glass Technology. The work to be undertaken will not duplicate the other researches into glass carried on elsewhere. On the other hand, it will be kept in close touch with them. This co-ordination has been greatly facilitated by the establishment of the Society of Glass Technologists, founded by a few of the active and enthusiastic workers at the technology of glass in and near Sheffield. It now includes all the progressive manufacturers as well as the men of science interested in the subject.

New Institute of Technical Optics.

Closely related to problems of glass are those of optics and optical instruments. For that reason we established a single Standing Committee to deal with both subjects. But here, as in every direction, we have found that no sound progress in research is possible without strengthening the bases of our national education. We therefore welcomed the untiring perseverance of the London County Council, which has during

[1] Report of National Physical Laboratory, 1916-17 p 63.

[2] Report of the Committee of the Privy Council for Scientific and Industrial Research, 1915-16, p. 34. [Cd. 8336.]

many years pressed for the establishment of a National Institute of Technical Optics. In the spring of 1916 the Higher Education Sub-Committee of the London County Council put a scheme before the Board of Education, which included the establishment of a new department for post-graduate education and research at the Imperial College, the strengthening of the existing department of technical optics at the Northampton Polytechnic Institute, and the appoinment of a single director with a specially constituted committee to supervise the work, both at South Kensington and Clerkenwell. The London County Council offered to defray one-quarter of the capital and maintenance charges of the new department at the Imperial College, and has accordingly contributed 1000*l.* a year for maintenance, with a special capital sum of 2500*l.* for alterations and equipment. The scheme appeared to us to be promising, and after conference with the Board of Education, the London County Council, and the Imperial College, we recommended your lordships to make a grant of 750*l.* for special apparatus and an annual maintenance grant of 1000*l.* a year for five years provided the scheme agreed upon at the joint conference was put in force. The governors of the Imperial College offered the necessary accommodation for the proposed department, and later voted a sum of 2000*l.* for equipment. After further negotiation with the governors of the Northampton Polytechnic Institute and with the Board of Scientific Societies, which had interested itself in the project, the scheme was adopted by all the bodies immediately concerned.

NEW SERIES OF OPTICAL TEXT-BOOKS.

With a due regard to the needs of the industry and of research students in technical optics, our Glass and Optical Instruments Committee have directed our attention to the deficiency of books in the English language on geometrical and technical optics. They recommend that a series of foreign works on these subjects should be translated and published, with corrections and additions, a proposal strongly supported by the Ministry of Munitions. We have endorsed this recommendation, and the Committee of Council have accordingly authorised the issue by the department of revised versions in English of the following standard works at cost price:—

Von Rohr: "Die Theorie der optischen Instrumente," vol. i., "Die Bilderzeugung in optischen Instrumenten."

Gleichen: "Die Theorie der modernen optischen Instrumente."

Ferraris (Tr. by Lippich): "Die Fundamental-Eigenschaften der dioptrischen Instrumente."

At the close of our report last year we remarked that "if it is supposed that modern industry can be developed or even maintained by a process of detailed investigations, a series of particular inquiries, however careful, the time, trouble, and expense will be largely wasted." We are not likely, therefore, to suppose that the considerable number of inquiries we have initiated are any adequate measure of the progress made in dealing with the difficult situation with which British industry is faced. Whatever has been accomplished would be better understood by comparing the general attitude of manufacturers to-day with their attitude before the war, or even eighteen months ago; by noticing the rapidity with which men of science at long last are coming to their own; by listening to the altered tone of all classes, and not least the men of business, towards the claims of education. May we add that if our labours are helping to prepare one of the roads for the coming advance, it will be due in the main to our conviction that roads can only be built in country that has been adequately surveyed?

BOOKS RECEIVED.

Chile. Pp. 301. (Santiago: Chilian Government.)

Hygrometric Tables for Use with Rotating Dry and Wet Bulb Thermometers. By Dr. W. Doberck. Pp. 17. (London: Williams and Norgate.) 2*s.* 6*d.* net.

Introduction to the Calculus of Variations. By Prof. W. E. Byerly. Pp. 48. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.) 3*s.* 6*d.* net.

Health in Camp. By Dr. A. T. Nankivell. Pp. ix+84. (London: Constable and Co., Ltd.) 1*s.* net.

Papers from the Geological Department, Glasgow University. Vol. iii., 1916. (Glasgow: J. Maclehose and Sons.)

Introduction to the Physiology and Psychology of Sex. By Dr. S. Herbert. Pp. xii+136. (London: A. and C. Black, Ltd.) 3*s.* 6*d.* net.

Technical Handbook of Oils, Fats, and Waxes. By P. J. Fryer and F. E. Weston. Vol. i., Chemical and General. Pp. x+279+plates xxxvi. (Cambridge: At the University Press.) 9*s.* net.

Bedfordshire. By C. G. Chambers. Pp. x+195. (Cambridge: At the University Press.) 1*s.* 6*d.* net.

The Theory of the Submarine Telegraph and Telephone Cable. By Dr. H. W. Malcolm. Pp. xi+565. (London: *Electrician* Printing and Publishing Co., Ltd.) 18*s.* net.

The Jewish Child: Its History, Folklore, Biology, and Sociology. By W. M. Feldman. Pp. xxvi+451+plates ii. (London: Baillière and Co.) 10*s.* 6*d.* net.

Zur Auffassung der Verwandtschafts-Verhältnisse der Tiere. By J. E. V. Boas. Pp. 61. (Kopenhagen: A. Bays.) 3 kroner.

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THURSDAY, SEPTEMBER 13, 1917.

FOUNDATIONS OF BIO-PHYSICS.

On Growth and Form. By D'Arcy Wentworth Thompson. Pp. xv+793. (Cambridge: At the University Press, 1917.) Price 21s. net.

THIS book, at once substantial and stately, is to the credit of British science and an achievement for its distinguished author to be proud of. It is like one of Darwin's books, well-considered, patiently wrought-out, learned, and cautious—a disclosure of the scientific spirit. It is an application of some of the concepts of physical science and sundry mathematical methods to the study of organic form. "My sole purpose is to correlate with mathematical statement and physical law certain of the simpler outward phenomena of organic growth and structure or form: while all the while regarding, *ex hypothesi,* for the purposes of this correlation, the fabric of the organism as a material and mechanical configuration." "Of how it is that the soul informs the body, physical science teaches me nothing. . . . But of the construction and growth and working of the body, as of all that is of the earth earthy, physical science is, in my humble opinion, our only teacher and guide." We think that it will be difficult to justify the word "only," for in the working of the body the soul (to use the author's dualistic terminology) takes part, as when a strong emotion influences our suprarenals, and, willy-nilly, we are back in psycho-biology.

The author begins with the general "principle of similitude," first laid down by Galileo, who showed that "neither can man build a house nor can Nature construct an animal beyond a certain size, while retaining the same proportions and employing the same materials as sufficed in the case of a smaller structure." The exposition of this illustrates in a vivid way "the profound differences of physical property and potentiality which are associated in the scale of magnitude with simple differences in degree." This is introductory to a fine discussion of the rate of growth, for the form of the organism is usually a direct expression of a rate of growth which varies according to its different directions.

"The velocities in different directions tend to maintain a *ratio* which is more or less constant for each specific organism; and to this regularity is due the fact that the form of the organism is in general regular and constant."

The author has dwelt most on those aspects of organic growth which have their analogies among inanimate things. He says comparatively little in regard to the regulative phenomena which are so distinctive in the growth of organisms; and his reference to the experiments of Gudernatsch, for instance, is inadequate. Not enough is allowed, as it seems to us, for the extraordinary differences of form which may result from a slight environmental difference—for instance, in the experimentally altered fates of the indifferent larvæ of Bonellia. The final form depends on the occurrence or non-occurrence of certain differentiations, and that depends on biochemical conditions. Then again, the remarkable disturbances of form which result from the introduction of toxic substances into developing embryos (see Werber's work) suggest that form depends on more than accelerations and retardations of growth in different directions.

"The cell, which Goodsir spoke of as a 'centre of force,' is in reality a 'sphere of action' of certain more or less localised forces; and of these, surface-tension is the particular force which is especially responsible for giving to the cell its outline and its morphological individuality." In a fascinating discussion Prof. Thompson shows that cell-division and other intra-cellular phenomena may be tentatively explained as the results of a conflict between surface-tension and its opposing forces. He favours the provisional assumption that "the phenomena of karyokinesis are analogous to, if not identical with, those of a bipolar electrical field." This leads on to an interpretation of the forms of free cells as essentially dependent on surface tension. "The simple fact is that the agreement of cell-forms with the forms which physical experiment and mathematical theory assign to liquids under the influence of surface tension, is so frequently and often so typically manifested, that we are led, or driven, to accept the surface tension hypothesis as generally applicable and as equivalent to a universal law."

Utilising the facts of adsorption and Macallum's fine researches, the author shows very cleverly how apparent exceptions may prove the rule. He proceeds to the more complex problem of interpreting the forms of cells in aggregates, utilising Leduc's remarkable "artificial tissues," and he shows the courage of his convictions in attacking the problem of the formation of blastula and gastrula. In an elaborate survey of a great variety of tissues he shows that it is possible to go a long way in interpretation with the help and guidance which the phenomena of surface-tension, the laws of equilibrium, and the principle of minimal areas are at hand to supply. Attention is directed to the fact that "all possible groupings or arrangements whatsoever of eight cells (where all take part in the *surface* of the group, none being submerged or wholly enveloped by the rest) are referable to some one or other of *thirteen* types or forms," or probably fewer than thirteen, "for there is reason to believe that, out of the total number of possible groupings, a certain small number are essentially unstable, and have at best, in the concrete, but a transitory and evanescent existence."

A very interesting chapter deals with concretions, spicules, and spicular skeletons. The form of the spicule may depend simply on its chemical nature; or the inorganic solid material may be laid down in conformity with the shapes assumed by the cells, tissues, or organs; or there may be intermediate cases where the molecular forces play their part in conjunction with, and

under the restraint of, the other forces inherent in the system. What is known as to the precipitation of calcium salts in various colloids, and as to similar phenomena, is used in the interpretation of the spicules of Sponges and Alcyonarians and the skeletons of Radiolarians and Foraminifers. There seems to be much in such formations that is not in any essential way dependent on their occurrence within living creatures.

"But every now and then we come to certain deep-seated signs of protoplasmic symmetry or polarisation, which seem to lie beyond the reach of the ordinary physical forces. It by no means follows that the forces in question are not essentially physical forces, more obscure and less familiar to us than the rest," comparable, for instance, with the formative force which Lehmann demonstrated in "fluid crystallisation." Crucial experiments are, we admit, awanting, but our faith is strained by the author's physical account of the apparently selective behaviour of certain Foraminifera which make for themselves very effective encasements of particular kinds of materials, such as sponge-spicules. We are inclined to think, also, that the author exaggerates the fluidity of Alcyonarian "species," for while his reproach may be justified in some genera, the striking feature in others is the rigid specificity, specimen after specimen like the duplicate of its predecessor, the absence of inter-grades, the clean-cut peculiarity of many of the spicular forms, and the individuality of the architecture around the polypes.

An attractive chapter deals with the logarithmic spiral which is of such widespread occurrence among animals, notably among Gasteropods. "In the growth of a shell, we can conceive no simpler law than this, namely, that it shall widen and lengthen in the same unvarying proportions: and this simplest of laws is that which Nature tends to follow. The shell, like the creature within it, grows in size, *but does not change its shape*; and the existence of this constant relativity of growth, or constant similarity of form, is of the essence, and may be made the basis of a definition, of the logarithmic spiral." From this type have evolved multitudinous diversities of form, mathematically identical, and natural selection may well be relieved of the burden of them. Of the author's explanations of horns and phyllotaxis, of the eggs of birds and the tests of sea-urchins, we have no space left to speak. We must, however, direct attention to what seems to us a slight blemish on p. 660, where the author adheres to a mechanical interpretation of the position of the spine on Bilharzia eggs, an interpretation which "destroys the chief evidence for the existence of a supposed new species of worm, a continued belief in which, among worms of such great pathogenic importance, might lead to gravely erroneous pathological deduction." We do not understand why Prof. Thompson deliberately allowed this to remain, knowing, as a note indicates, of Dr. Leiper's recent work, which does far more than assert that terminal and lateral spined eggs belong to separate and distinct species of Bilharzia. Is there not a risk that the retention of the page may "lead to gravely erroneous pathological deductions"?

With the often fanciful utilitarian interpretations of coloration and markings, of which a deliciously ironical exposition is given, the author contrasts the deep-seated adaptations of structure to mechanical efficiency, seen so well in a bone, where statical and dynamical considerations can be applied and established in detail. The book closes with a luminous essay on "the theory of transformations, or the comparison of related forms," in which it is shown, to put the matter rather roughly, how one harmonious deformation may lead from one skull or leaf to that of a related type, how trammels or lines of constraint may determine the action of the expansive forces of growth, now in one direction and again in another.

We offer Prof. D'Arcy Thompson felicitations on his masterly book. It marks a big advance in science, and it will make other advances possible. He has used his own observations and those of a hundred others to show, in a way that will surprise and delight many, what promise there is in the endeavour to carry into the study of living beings the laws and lessons of the inorganic. When first we laid the book down, we were tempted to say, "Magnificent, but not biology," but wiser reflections prevailed. Who knows better than the author what biology is and is not? We saw that he was but putting heredity and variation temporarily aside for his purpose, "to show that a certain mathematical aspect of morphology, to which as yet the morphologist gives little heed, is interwoven with his problems, complementary to his descriptive task, and helpful, nay, essential, to his proper study and comprehension of form." We would go further, and say that his argument, couched in a style that is always clear and dignified, and at times bewitchingly beautiful, has given us a fresh revelation of the unity of Nature.

J. Arthur Thomson.

SCIENCE AND INDUSTRY.

The Chemistry of Dyestuffs: A Manual for Students of Chemistry and Dyeing. By M. Fort and Dr. L. L. Lloyd. ("Cambridge Technical Series.") Pp. xi+311. (Cambridge: At the University Press, 1917.) Price 7*s*. 6*d*. net.

This work, which has the scope of an elementary text-book, is a useful addition to the rapidly increasing number of manuals in the English language devoted to the subject of dyes and their intermediate products. The authors point out that the opportunity of development now presenting itself to the colour manufacturer in this country will lead to a greater interest in the chemistry of dyes and to an increasing demand for chemists possessing special knowledge of colouring matters. To the student equipped with

a knowledge of pure chemistry this treatise will prove an efficient guide to one of the most complicated and technical branches of applied chemistry.

The introductory chapters deal with the history of synthetic dyes and the nature of coal tar. It is of interest to note how remarkably the nature of tar varies with the temperature at which coal is distilled. When produced at 400–500° C. the tar is rich in volatile hydrocarbons, especially paraffins, and is valueless for the colour maker. At 900–1000° C. an optimum yield of aromatic (benzenoid) compounds is obtained. Tar produced at the higher temperatures contains, roughly, the following percentage amounts of important direct coal-tar products:—Benzene, 2; toluene, 0·5; phenol, 0·6; naphthalene, 5–6; and anthracene, 0·6. It is on these five substances, together with two or three others obtained in even smaller proportions, that the great synthetic colour industry is based.

Ten chapters are devoted to an explanation of the chemical processes whereby the foregoing direct coal-tar products are converted into intermediate products, or "intermediates." Sufficient theoretical matter is introduced into this section to make the practical details readable and connected. For example, the constitutions of quinones and diazo-compounds are treated fully because of their bearing on the structure of organic dyes.

The chapter on the application of dyes refers to the dyer's classification of colouring matters into acid, basic, mordant, direct cotton, vat, or sulphide dyes. Concrete examples are given of each of these groups of dyes with appropriate methods of applying the colouring matters to the textile fibres.

A chapter on the colour and constitution of dyes and coloured substances is followed by eleven chapters devoted to the synthetic dyes classified under their respective chromophores or characteristic colour-bearing groups.

One of the most informing of these sections is the chapter on vat dyes. In this group we find the oldest and newest colouring matters known to dyers. Indigo and Tyrian purple were used by the ancients, whereas the other indigoid dyes and the anthraquinone vat and sulphurised vat dyes have all been discovered since the commencement of the twentieth century.

The last chapter describes the principal natural dyes, a group of colouring matters which has during the war regained a certain amount of its former importance owing to the shortage of synthetic dyes.

The authors are fully alive to the national importance of establishing a British sphere of influence in dyes, and as an outward and visible sign of this sentiment perhaps they might be persuaded to drop the inelegant expression "dyestuffs," obviously a literal translation of "Farbstoffe," in favour of such English terms as dyes, colouring matters, and dyewares.

G. T. MORGAN.

LUIGI CREMONA.

Opere Matematiche. Di Luigi Cremona. Tomo Terzo. Pp. xxii+520. (Milano: Ulrico Hoepli, 1917.) Price Lire 30.

THIS final volume of Cremona's collected mathematical works contains thirty-six papers, including the treatise on the general theory of surfaces, the memoir on cubic surfaces, the tract on reciprocal figures in graphical statics, and various notes on birational transformations in space. Prefixed thereto is a biographical notice by Prof. E. Bertini, giving many interesting details of Cremona's career.

For many years Cremona was better known to English readers than were the majority of foreign mathematicians; and it is not difficult to give reasons for the fact. So far as the geometry of algebraic surfaces is concerned, he and Salmon were kindred spirits; and the latter gives numerous references, in his "Solid Geometry," to Cremona's investigations.

Then the Clarendon Press published two excellent English translations of his "Elements of Projective Geometry" and "Graphical Statics" at a time when interest in these subjects had been aroused by Henry Smith, Clerk Maxwell, and others. Finally, Cremona's cast of mind and style of composition could, and did, appeal successfully to English mathematical taste.

Perhaps Cremona's greatest achievements were due to his superb qualities as a teacher and educationist. Though he lived until June 10, 1903, the last of his mathematical papers appeared in Proc. L.M.S. for 1884; and the reason was that the Italian Government, recognising his value, appointed him to posts of such importance as to absorb all his energies. This is not the place to estimate his services to the Italian system of education; but they were undoubtedly very great, especially in such things as the courses given in engineering.

Cremona's ultimate rank as an original mathematician will probably rest mainly on his discoveries in the algebraical theory of birational transformations; and it is not without justice that the term "Cremona transformations" has been adopted for the simplest class of them. As developed by Nöther and others, this theory is of cardinal importance, both in analytical geometry and in the theory of Abelian functions; and we may fairly say that Cremona was the first to demonstrate its value and give brilliant and original applications of it. As an exponent of novel and comprehensive theories he displays qualities of the very highest order. G. B. M.

OUR BOOKSHELF.

Scientific Treatise on Smoke Abatement. By H. Hamilton. Pp. xiii+155. (Manchester: Sherratt and Hughes, 1917.) Price 5*s*. net.

IT is a little unfortunate that the term "scientific" should have been included in the title of this book, seeing that the author is clearly more familiar with the subject of mechanical engineering

which should be represented Great Britain, the Dominions, India, and other parts of the Empire," and no doubt both the recommendation of the War Conference and the later action of the Ministry of Munitions were powerfully influenced by the memorandum to this effect drawn up by the technical institutes that are most closely in touch with the exploitation of our mineral deposits and the utilisation of their products. The Ministry of Munitions cannot fairly be accused of undue haste, seeing that it is nearly a twelvemonth since the institutes directed attention to this important matter, which was commented on in the columns of NATURE of October 5, 1916; it is to be hoped that effect will be given promptly and energetically to the findings of the committee, although it is perhaps even more important that the scheme put forward shall be a thoroughly sound one and that it shall deal with every aspect of this very large subject.

The importance of the subject may best be gauged by considering that the number of workers employed in the mines and quarries of the British Empire was at least 2½ millions in 1913, and that the value of the mineral products at the point of their production was about 150,000,000*l.* sterling in the same year. This vast sum represents the value of minerals extracted from Imperial mineral deposits, and this means that the assets of the Empire are diminished by this amount every year; it cannot be too often insisted upon that it is this fact, in respect of which the mineral industry is unique amongst all others—namely, that minerals constitute a wasting asset, which, once taken from the ground, can never be renewed or recovered—that renders the establishment of a bureau to watch over the proper development and utilisation of our mineral resources an imperative necessity. The figure given above refers only to the value of the crude minerals at the mine; it need scarcely be said that the products obtained from, and depending upon, the mineral output are worth many times as much, in the same way that the number of workers engaged in the treatment of mineral products and depending also upon them is far greater than the number above stated, even when only the industries directly connected with the mineral production, such as the metallurgical industries, are considered.

It must, however, not be forgotten that the industries indirectly connected with the exploitation of minerals are very widely ramified, and are so complex that it is not easy to foresee all the results that may arise from any change in the direct treatment of the minerals themselves, and no doubt these considerations will need the most careful study by the bureau. To take an example, it is quite possible that one of the first questions that the bureau will have to consider is the extent to which metalliferous minerals should be smelted in the country of their origin, or alternatively imported as such to be smelted in this country; it may surely be taken for granted that the old blunder of allowing other nations to import our crude minerals and to reap the advantage of treating them outside the Empire will never be repeated. At first sight, having regard to the fact that for some time after the termination of the war there must be a shortage of tonnage, it might seem preferable to smelt, for example, Australian zinc concentrates in Australia, and to ship the smelted spelter to this country; if, however, this principle were carried too far, we might find that the diminished importation of sulphide ores might bring about a scarcity of sulphuric acid in this country, which might easily cripple our chemical industries, or, by affecting the output of sulphate of ammonia, might influence our agricultural production very adversely.

Obviously, if the Mineral Resources Bureau is to be of real value, it must be able to dispose of the fullest possible technical and scientific information, and it ought for this purpose to work in the closest possible co-operation, not only with the Department of Scientific and Industrial Research (which is already doing useful work in encouraging such researches as that now being conducted upon the dressing of ores of tin and wolfram), but above all with the technical institutions devoted to the advance of the mining and metallurgical industries. No doubt the ideal arrangement would be for the bureau and these various institutions all to be housed in one building, so as to be able to communicate with each other with the utmost readiness, and, above all, to have one common library, in which all books, papers, statistics, and information of any kind concerning mineral production should be housed. Such a joint library should be second to none in the world, and given its indispensable adjunct—a competent librarian—all information concerning any aspect of any mineral question should be readily available to anyone interested. Such a collection of all existing information should be one of the first cares of a Mineral Resources Bureau; only those who have been actually engaged in such work know how much time and money are being continually wasted in doing over again work that has already been done, merely because the records are not readily available to any inquirer.

Again, there is probably no industry that is so many-sided as the mineral industry, and therefore none in which there are so many specialists; it is safe to say that such specialists are best known to the secretaries of the technical institutions, who are necessarily in close touch with them, and an intimate co-operation between the bureau and these institutions would enable the former to get the benefit of the assistance of the best specialists in any problem that may arise in the readiest and most effective manner. Finally, it may fairly be hoped that close connection with the institutions, and through them with the men actually engaged in the mineral industries, may save the activities of the bureau from being strangled by official red-tape. The proper development of our mineral resources is of such importance to the future of the Empire that the organisation of this bureau, which could do so much for them if it is properly constituted, will be watched with the greatest anxiety.

HENRY LOUIS.

LINGUISTIC AND POLITICAL BOUNDARIES IN EUROPE.

NATIONALITY is to serve as an important factor in determining the boundaries of the New Europe. On broad lines the safest guide to the nationality of any populace is the language commonly spoken, usually the mother-tongue. Hence the importance of a map like that[1] lately published by Messrs. Stanford. Consider for a moment the political boundaries, both international and national, of Austria-Hungary. Practically nowhere do they coincide with a linguistic boundary. The only people wholly within that empire are the Magyars, who inhabit a compact block of territory bounded on the south by the Drave and the Maros, on the north by the foothills of the Carpathians, on the west by a line slightly west of south from Pressburg to the Drave, and on the east by a line north-east from Arad. South-east of the Magyars lie the Rumanians, who extend beyond the Carpathian political boundary; they include islands of Magyar and German settlers, former frontier guards. Along the south and to the south-west the great group of the Yugo-Slavs (Serbs, Croats, and Slovenes) extends beyond the confines of Austria-Hungary. To the west lie the Austrian Germans, who fill the Danube valley westwards beyond the frontier. North-west are the Slovaks, who link with the Moravians and Czechs as one great branch of the northern Slavs. These peoples do not reach the Austro-German frontier, since they meet the Germans within the borders of Bohemia, or the Austro-Russian frontier, since they meet the Poles. To the north-east the Magyars adjoin the Ruthenes, or Little Russians, whose limit is far to the east beyond the Don.

Suppose an independent Magyar kingdom be established, what are the chances of stability? First, a homogeneous race; secondly, a zone railway system which concentrates on the capital, Budapest; and, thirdly, a unity of soil, climate, and products mainly agricultural—all these tend to preservation. On the other hand, there would be no Magyar outlet to the sea, the two great waterways, Danube and Theiss, would not join in Magyar territory, and no boat could journey by Pressburg to Szabadka through Magyar territorial waters for the complete voyage. The great trunk railway from Vienna to Constantinople would only serve the south-western corner. Finally, would the Magyar kingdom march with Russia on the north-east and with Germany on the west?

Contrast this kingdom with Poland, cut across by pre-war international boundaries. The Poles form the most numerous non-German people in the German Empire; they extend into Austrian Silesia, and practically fill Galicia west of the San. Unlike the Magyars, the Poles reach the sea, along a few miles of coast west of Danzig. They march, however, with Germans on the west, with Russians on the east, and with a Slav people —Czecho-Slovaks—on the south-west. The linguistic boundaries of Magyars and of Poles rarely lie along rivers or mountain ranges; will the new era bring into play new factors which will determine the stability and utility of political boundaries?

Messrs. Stanford have done a public service in publishing this map, which should be examined and re-examined by all who are interested in the determination of the conditions which will make for a lasting peace.

[1] "A Sketch-map of the Linguistic Areas of Europe." Scale, 50·8 miles = 1 in. (London: Edward Stanford, Ltd.) Price, in 4 sheets, 72 in. by 61 in., 2*l.* 2*s.*; mounted on rollers, 2*l.* 15*s.*; folded in cloth case, 3*l.* 10*s.*

APPLIED ENTOMOLOGY IN CANADA.[1]

DR. GORDON HEWITT'S recent report is an encouraging record of useful work. It forms a noteworthy testimony of his capability as an administrator and, at the same time, reflects great credit upon the Canadian Department of Agriculture in its wise provision for the needs of combating insect pests. In any such organisation as the Canadian Entomological Branch success to a large extent is dependent upon the individual capabilities and enthusiasm of field officers and assistants. Dr. Hewitt is indeed fortunate in having an excellent staff, comprising men well qualified to deal with the various problems first hand, wherever they may be reported. During the year under review four new entomological field laboratories have been erected in several parts of Canada; this in itself is a praiseworthy achievement. An addition to the permanent staff has also been made in the appointment of Dr. A. E. Cameron. Dr. Cameron is a former research scholar of our own Board of Agriculture, and conducted investigations in the Department of Agricultural Entomology at Manchester University.

In a country like Canada, the administration of the Destructive Insect and Pest Act naturally involves a good deal of routine work. More than $2\frac{1}{4}$ millions of imported trees and plants were examined in 1914–15. This work had special reference to gipsy and brown-tail moths and other foreign insect pests. Dr. Hewitt tells us, however, that owing to the war this number is only about one-half of that imported during the corresponding period the previous year. It appears that the intensity of the infestation of these two moths in Nova Scotia and New Brunswick has decreased, though the area over which they have spread has become extended. An excellent feature is the co-operation which has taken place with the U.S. Government in suppressing these pests, and in introducing into Canada certain of their more important insect enemies. The army cutworm (*Chorizagrotis auxiliaris*) occurred as an extensive outbreak in a corn-producing area of about 3000 square miles in S. Alberta. Prompt measures were, however, undertaken and widespread damage prevented. The lesser migratory locust (*Melanoplus atlanis*) was very abundant in Eastern Canada, but the timely publication of an entomological circular on the subject disseminated neces-

[1] Report of the Dominion Entomologist for the Year ending March 31 1916. By Dr. C. Gordon Hewitt. Pp. 73+7 figs. (Ottawa, 1917.)

sary information, and serious losses were prevented where the measures advocated were carried out. The outstanding feature concerning fruit crops was an outbreak of the pear thrips in British Columbia, and investigations of its life-history and means of control are now being conducted. The warble-fly is also a problem of great importance, especially as the two common species of Hypoderma are extending their range in Canada, through the introduction of cattle from infested areas. A definite method of control, by legislation or otherwise, is an urgent need not only in Canada, but also in the British Isles.

Among other topics, insects affecting the household and public health claimed much attention, also the protection of birds and mammals, and the arrangement of the national collections of insects.

A. D. IMMS.

EDOUARD SARASIN, (1843–1917).

WHILE the best young shoots are being ruthlessly destroyed the mature grain is being harvested. Edouard Sarasin has passed away. In him Science deplores the loss of a distinguished physicist, and Geneva a great man of an historic race, whose traditions, however, do not cease with him.

The place which Sarasin held in the world of science was in no way due to official position. He was at no time a professor at the university. The admirer of his work who sought him at the University of Geneva did not find him, and was told: "Edouard Sarasin? He is Maire of Grand Saeonnex." In answer to a puzzled question as to his academic position they would say: "He is President of the Société Helvétique, and editor of the Archives des Sciences physiques et naturelles."

Sarasin's experimental work, which was of the first order, was carried out at a private laboratory, often in collaboration with friends, whose names are no less illustrious than his own. He was not the head of a school, but a bright star in a galaxy. These men of science grew up under the influence of Auguste de la Rive; and Sarasin's first essay, dealing with electric discharges in rarefied media in presence of a magnet, were prompted by that great master. At the same time, under Soret, he was obtaining results which have become classical; among these we may mention the refractive indices of quartz, Iceland spar and fluorspar, still printed in the tables.

It was however in collaboration with Lucien de La Rive, the son of Auguste, that Sarasin's best known work in physics was achieved. This consisted in the experimental development of the Maxwell-Hertz theory. The discovery of "multiple resonance" is one of the results due to them. It is in virtue of this property that, for instance, a Marconigram may be picked up in transmission by any resonator. The last scientific work with which Sarasin was, only recently, engaged, consisted in delicate experiments on radio-activity, carried out in conjunction with Tommasina. At Geneva, however, the man of science cannot remain mewed up in a laboratory. Nature tempts him with her beauty and her mystery. Sarasin was a passionate lover of nature and an ardent student of the geophysics of his native land. We can but refer to the instrument invented by him for recording the "seiches"—those strange undulations which from time to time traverse the Lake Leman, and to his photographic studies on the penetration of light under water.

The reader who desires a fuller information as to the work of Sarasin is referred to the interesting article by C. E. Guye in the *Journal de Genève* of June 26, as well as to the forthcoming account by L. de la Rive in the Archives des Sciences.

GRACE CHISHOLM YOUNG.

NOTES.

SIR GEORGE GREENHILL reminds us, in connection with the correspondence on unusual rainbows in NATURE of August 30 and September 6, that letters upon this subject appeared in NATURE of January 23 and February 6, 1890 (vol. xli., pp. 271 and 316). In the issue of the former date Lord Kelvin sent a letter, with a diagram, showing a rainbow caused by reflection, and this was followed on February 6 by an illustrated description of eight rainbows seen at one time by Dr. Percival Frost. Lord Kelvin, in sending this letter, said:—"The theory of the rainbows produced by the sun itself directly, and by the image of the sun reflected from still water, is given in Prof. Tait's book on 'Light.' The phenomena seems to have been observed by Halley in 1698 (see NATURE, vol. x., pp. 437, 460, and 483 for interesting correspondence on the subject)." Referring to the observation described in NATURE of August 30, Mr. J. H. Grace writes from Cambridge to direct attention to a note in the Transactions of the Royal Irish Academy, bearing date November 14, 1826, and written by the Lord Bishop of Down and Connor, where there is a striking coloured diagram which illustrates the point raised by Mr. Low. The Bishop remarks: "It cannot be doubted that the extraordinary, or centre, bow was occasioned by the image of the sun reflected from the surface of the water. The description and the figure answer exactly to this explanation."

THE Tokyo Press publishes the scheme for the inauguration in that city of a scientific and industrial research laboratory. The principal scope of the institution is to assist in the application of modern methods to the development of Japanese industries. The chief sections of the laboratory will be those devoted to researches in electricity, chemistry, electrochemistry, textiles, and metallurgy. To meet the expenses Parliament has passed a law authorising the Government to make a grant to the laboratory of two million yen (approximately 200,000*l.*), payable in instalments over ten years at the rate of 200,000 yen per annum. The Imperial Household has also made a lump sum grant of one million yen (100,000*l.*). At a recent meeting the promoters of the scheme elected a committee the object of which will be the collection of funds independent of the Government grants. A sum of 2,900,000 yen (290,000*l.*) has already been collected, so that the laboratory will have available funds exceeding five million yen (half a million sterling). These particulars are taken from a paragraph in *L'Economista d'Italia* for August 30.

DURING the last three strenuous years, much has been done to organise chemical industries, and there is every reason to hope that in the difficult period after

the war they will be able to present a united front to the problems which await solution. The very influential Association of British Chemical Manufacturers is now firmly established and doing much good spade-work. It is a hopeful sign that a healthy spirit of give-and-take is abroad, and the amalgamations which have been announced from time to time—notably that recently made public of the firms engaged in the explosives industry—are pregnant with meaning for the future. One of the most important industrial problems of the immediate future is the relation between capital and labour. A body provisionally termed the Wages Committee of Chemical Manufacturers, but which will shortly have a more national title, has been called into being for this purpose, and has already received the support of the majority of chemical employers. Its immediate object is the adjustment of wages questions arising out of the present abnormal cost of living, but ultimately it will probably act together with the trade union representatives as the clearing-house for all questions affecting the relation of masters and men in the industry on the lines suggested by the Whitley Commission. Although the association and the Wages Committee are necessarily separate bodies they will work together in the closest harmony. We have received particulars of the formation of a new body with the title of the National Association of Industrial Chemists, which appears to be a trades union of industrial chemists. The objects of the new body are the economic, intellectual, and social advancement of industrial chemists, and the promotion of the interests of its members by collective action. A start has been made in the Sheffield district, where the new union has received general support. The development of the new association will be watched with interest.

IN an article in the issue of the *Scientific American* for August 18 Mr. C. H. Claudy gives a brief account of the way in which the resources of science are being mobilised for war by the United States. He explains how the National Research Council, the constitution of which has already been described in these columns, is acting as the Department of Science and Research of the Council of National Defence—which means that practically every research laboratory and practically every man of science is at the service of the United States, and to a large extent now engaged in war work. The National Research Council includes the chiefs of the technical bureaus of the Army and Navy, heads of Government bureaus engaged in scientific research, and groups of investigators representing educational institutions, research foundations, and representatives of industrial and engineering research. The representatives of the Government were appointed by the President. The chairman, Dr. G. E. Hale, the director of Mount Wilson Solar Observatory, is giving his entire time to the work in Washington. The work of the council is being done by about thirty-one committees, and naturally no details of the results of their labours are available for publication. As an example of the activities of the council it may be said that the Physics Committee is engaged in an exhaustive study for detecting submerged submarines and mines, in studying and devising range-finders of various types and instruments for the discovery of invisible aircraft and sapping parties, as well as in making improvements in wireless and other instruments used in the air. The greatest research laboratories, outside those of the universities, are maintained by some of the large manufacturing establishments. Several of these have not only offered their services, but have turned over whole staffs of experts, as well as the most complete of laboratory equipments, to the work of the council. Mr. Claudy sums up the work of the council by saying it can be considered as a clearing-house for men of science, a mobilising office for scientific facilities. "It provides the short cut between the man who knows the problem and the men who may find the answer. It has made a solid unit out of the laboratory and research facilities of the country and provided itself with such complete information that there is practically no question which Army or Navy can ask of science that it cannot supply the best man, the best equipment, to attempt to find the answer."

WE notice with regret the announcement in the *Times* of September 8 that Prof. Adolf von Baeyer, foreign member of the Royal Society, and Liebig's successor in the chair of chemistry at the University of Munich, has just died in his eighty-second year.

DURING the past season Dr. Smith Woodward has spent six weeks, partly in association with Prof. Elliot Smith and Major C. Ashburnham, in exploring the Piltdown gravel. Although a large amount of undisturbed material was sifted and carefully examined round the periphery of the pit in which the original discovery of Eoanthropus was made, nothing was found except one unimportant fragment of the tibia of a deer.

THE *Times* announces the death on September 10, on the eve of his eighty-seventh birthday, of Mr. Percy G. Westmacott, one of the notable engineers of the middle of last century. Mr. Westmacott was a pioneer in the use of hydraulics, specially for cranes, lock-gates, bridges, and grain elevators, etc., the swing bridge at Newcastle being one of the best-known examples of his inventions in this line. He collaborated throughout in the construction and development of the famous Armstrong gun. He was president of the Institution of Mechanical Engineers in 1883 and 1884, and only gave up his close association with engineering work in 1887 owing to ill-health.

THE ninety-ninth annual meeting of the Société Helvétique des Sciences Naturelles is being held this week at Zürich. The following lectures are included in the programme:—Prof. A. L. Perrier (Lausanne), The orientation of molecules in physics and crystallography: a sketch of a fruitful hypothesis and its consequences; Prof. F. Baltzer (Bern), The development and heredity of bastards; Prof. R. Chodat (Geneva), A botanic voyage to Paraguay; Prof. E. Bleuler (Zürich), The newest psychological directions in psychiatry and their importance in other subjects; Prof. E. Argand (Neuchâtel), the phases of alpine folding; Friedrich Schmid (Oberhelfenschwyl), The zodiacal light, a chapter in meteorological optics.

THE loss of its librarian, Mr. E. E. Riseley, who was killed in action on August 1, will be severely felt by the Linnean Society. Mr. Riseley was born at Abbots Ripton, on February 15, 1889, the only son of his parents, and at the age of fifteen became library clerk to the Zoological Society; there he acquired an excellent knowledge of zoological literature and library methods, which stood him in good stead when he became assistant librarian to the Linnean Society in the spring of 1914. From the autumn of that year he was the librarian, and his energy resulted in great improvements in the arrangement of the books, whilst his quickly gained knowledge of the special volumes in the library, made his services greatly appreciated, and a long career seemed to be his, when it was suddenly cut short by his death.

BY the death of Prof. Eduard Buchner, professor of chemistry, Breslau University, on the Western front near Verdun, Germany has lost one of her most distinguished workers in the field of biochemistry. It was in 1897 that Buchner made the memorable observation

that the yeast-juice prepared by Hans Buchner (his brother) and Martin Hahn, by grinding yeast with sand and pressing out with kieselguhr, had the power of fermenting sugar, although it was quite free from yeast cells. Thus was solved a problem which had defied the experimental resources of Pasteur and many others of less renown, and thus was established the fundamental principle that processes of fermentation are not inalienably dependent on the life of the organism, but are carried out by chemical agents, which may be removed from the cell without loss of function. Buchner's discovery, established in the face of strenuous criticism by careful and thorough experiments (collected and published in "Die Zymasegärung"), was received with intense interest by the scientific world, and acted as a great stimulus to research in biochemistry, the effects of which are by no means yet exhausted. Buchner himself was awarded a Nobel prize in chemistry (1907) and received the honours bestowed by Germany with unsparing hand upon her successful men of science. The experiments were extended to bacteria, and, although unexpected difficulties were encountered, it was proved that the same principle applied to these, the simplest of all living organisms. The work of Buchner must be regarded as marking a definite step forward in the exploration of the mysteries of the living cell. By it the frontier of chemical and physical explanation is advanced a stage and the unexplained residuum is at once diminished in area and more clearly outlined.

MAJOR A. N. LEEDS, whose death on August 25 we have already announced, was born at Eyebury, Peterborough, on March 9, 1847, and educated at the Warwick Grammar School. His early ambition was to enter the medical profession, but circumstances compelled him in 1868 to take over the management of the farm of his deceased father. There, in association with his brother, Mr. C. E. Leeds, who was then studying at Oxford, he became interested in the fossil bones of reptiles found in the brickfields in the Oxford Clay near Peterborough, and he spent the leisure of the rest of his life in collecting these fossils in a manner more systematic and scientific than had ever been attempted before. For about twenty years the two brothers worked together, until Mr. C. Leeds left this country for New Zealand. After that Major A. Leeds continued the collecting alone, aided only in the work of preparation by his accomplished wife, and occasionally by one of his sons, Mr. E. T. Leeds, now of the Ashmolean Museum, Oxford. From 1890 onwards all the most important specimens in the Leeds collection were gradually acquired by the British Museum, where they now form a unique series illustrating the osteology of the Ichthyosauria, Plesiosauria, Pliosauria, and marine Crocodilia, besides parts of certain Dinosauria. They are specially valuable because all the bones are completely extricated from the soft clay in which they were embedded, and many of the skeletons can be mounted like those of modern animals. The marine forms are described by Dr. C. W. Andrews in two exhaustive and well-illustrated volumes published by the trustees of the British Museum. Major Leeds also discovered many new fishes, which were described by Dr. Smith Woodward. In recognition of the scientific value of his work he was awarded the Lyell Fund by the Geological Society in 1893.

THE Departmental Committee appointed to inquire into the condition of the freshwater fisheries, as a possible emergency source of food, has issued an interim report. The investigation, which was carried out mainly by means of a *questionnaire*, dealt with trout, eels, and other coarse freshwater fishes, but not with salmon. The committee does not regard the available stock of such fishes as of much importance as an emergency food supply, and does not recommend any interference with the existing rights of owners and anglers. Most of the waters are privately owned, and the fish are therefore private property, so that exceptional exploitation would imply the payment of compensation. There are, it is stated, considerable quantities of migratory fishes, such as grey mullet, in the lower reaches of many rivers. Such waters are public ones, and the committee recommends the modification of any regulations which make the capture of these fishes difficult or impossible. The nutritive value of coarse freshwater fishes is dealt with. There are no available analyses of British species, but the committee gives a list of analytical results with respect to American and French fish. The food value appears to be very low. In a circular (Fisheries Notice, No. 8) sent out together with the report the Board of Agriculture and Fisheries gives a number of recipes dealing with methods of preparation, cooking, and smoking of coarse freshwater fishes.

THE forty-sixth annual report of the Deputy-Master and Comptroller of the Mint for the year 1915 has recently been issued. The outstanding feature of the year, so far as coinage is concerned, was the very great request for Imperial silver coin. The large demands which followed the outbreak of the war appeared to be satisfied by the spring of 1915. In August, however, when measures were taken to withdraw gold coin from circulation, it became clear that further large supplies of silver currency would be required. As against an average of under forty million silver pieces for the ten years 1905–14, no fewer than 105 million new silver coins were minted. In all more than 206 million new coins, of the value of 29,148,392*l.*, were put into circulation. The issue of gold coin was also above the average of the previous ten years, but was considerably below that of the four years 1910–13. Returns of gold coin held on June 30, 1915, were made by sixty-eight banks, and the total, 110,188,109*l.*, is the largest shown since the institution of the annual inquiry, exceeding the amount held in 1914 by more than twenty-seven million pounds. Compared with the results of the inquiry in 1909, when the returns of holdings were made on the same weekday, the total held in 1915 shows an increase of nearly 124 per cent. The profit on the year's working was 4,710,291*l.*, and was much the largest in the history of the institution. The increase was chiefly due to the profits on the large sales of silver coin in the year.

IN vol. xii., part 10, of the Publications on American Archæology and Ethnology, issued by the University of California, Mr. S. A. Barrett describes the ceremonies of the Pomo tribe. Twenty years have passed since the last of the Pomo ceremonies was held in true aboriginal fashion. Elaborate rites of the more recently introduced "Messiah" cult were held so late as fifteen years ago, but these include only a few features common to the indigenous tribal observances. The details of the chief ceremonies have now been collected from the recollection of aged members of the tribe, and the description contains much that is interesting. The tribal rites were characterised by the absence of any fixed ceremonial season or sequence of ritual, and they were not controlled by a powerful priesthood or secret order in charge of the observances. The ritual mainly consisted of dances, some of which were adopted as integral parts of certain ceremonies, while others were merely incidental to them. One ceremony had a definite mythological background, but at the present day no myths are told to explain several parts of the rites. A distinguishing feature was the prominent part played by the women.

In two dances the number of performers drawn from each sex was definitely prescribed; in five only men might participate, and two were exclusively performed by women.

UNDER the title of "Fuel Values of Foods," an article by Dr. C. F. Bolduan, of New York, appeared in the *Scientific American* of July 28, in which a novel method is indicated of bringing home to the public the importance of knowing the real nourishing value of the foods they buy. This consists in attaching to each food displayed for sale a card indicating its calorie value per lb. The calorie value is the best all-round index of the nourishing properties of a food. The older idea of attaching special importance to the protein content is now discarded, since it is practically impossible to obtain any combination of natural foods suitable for human use which does not provide sufficient of this foodstuff. To complete the lesson the price per lb. of each food should be attached as well. Dr. Bolduan is a well-known authority on subjects dealing with public health, and at his suggestion one firm of restaurant proprietors has adopted the principle of giving, in parentheses on the *menu*-card, numbers which indicate the calorie value of the dishes offered for choice. Thus "(632–429) cold ham or corned beef, potato salad, 20 cents," indicates that the portion supplied, if ham were selected, would have 632 calories, if beef were chosen 429 calories. A similar practice has long been in use at the Battle Creek Sanatorium. The article is accompanied by a full-page illustration of a suggested window display of foods on these lines, in which fruit, vegetables, nuts, cereal foods, fish, poultry, meat of various kinds, etc., are all included. Other illustrations represent tables laid out with (1) a breakfast, which supplies 650 calories; (2) a lunch providing 900 calories; and (3) a meatless dinner of 1100 calories, the whole being sufficient for a man leading a sedentary life. It is not unlikely that we may soon see this method of teaching economy in the use of foods adopted in this country.

THE claim of the gipsy moth (*Ocneria dispar*) to rank as a British species, its former abundance in the fen districts, and its final disappearance throughout Great Britain, are very clearly set forth by Mr. Robert Adkin in the Proceedings of the Entomological Society for 1916–17. There seems to be no justification for the belief, at one time held, that this was an introduced species, though it is curious that it was unknown to the older entomologists. At no time does it appear to have become unduly numerous with us, though in North America, where it was accidentally introduced, it has become a formidable pest.

THE existence of fluorescent bacteria has been recorded, though the colouring matter produced by them is insoluble in ether. Further, E. Rostrup has observed that *Agaricus* (*Pleurotus*) *serotinus*, Schrad., imparts a peculiar fluorescence to spirits of wine, and A. Ling found that a Torula occurring in ale gave to it a greenish fluorescence. Now Prof. A. Klocker (*Comptes rendus des travaux du Laboratoire de Carlsberg*, vol. ii., part 6) describes the production of a faint greenish fluorescence when *Aspergillus glaucus* is grown in a medium containing sugar, and the isolation of the colouring principle. When the medium (*e.g.* beer wort) in which *A. glaucus* has been grown is shaken with ether, the latter acquires a faint yellowish colour, and in thick layers a blue fluorescence. If the ethereal solution is shaken with ammonia this exhibits a very marked green fluorescence, whilst if soda be used the fluorescence is reddish-brown. On evaporation the ethereal solution leaves a yellow residue having the properties described. The substance is not fluorescein, though it resembles this compound. If the Aspergillus is grown on gelatinised beer wort the liquefied gelatine develops the fluorescence. The reaction seems to be specific for *A. glaucus* and *A. repens*.

DR. JOHN TAIT has published in vol. xxxvii. of the Proceedings of the Royal Society of Edinburgh a series of five papers under the general title of "Experiments and Observations on Crustacea." Some of the questions dealt with are purely physiological, as in the case of the first paper, which gives the results of experiments on the resistance of the terrestrial Isopod, Ligia, to immersion in fresh and in salt water. It was found that while immersion for prolonged periods in sea-water had little, if any, harmful effect, some of the specimens surviving for three months, distilled water proved fatal, within forty-eight hours, to specimens immersed in it. It is shown that this toxic effect is due, in all probability, to the withdrawal of essential salts from the body of the animal. Several papers deal with problems that are described as "semi-morphological," and in these the author shows a preference for far-fetched comparisons that seems to be characteristic of medical physiologists who touch on comparative morphology. The way in which the leg of the Isopod Ligia is bent is illustrated by "selecting, say, the limb of a land mammal for comparison." We are told that the correlation between the two is "sufficient to excite wonder." One paper gives an account of some points in the structure of the giant Antarctic Isopod, Glyptonotus, and includes the most detailed account yet published of the articular surfaces of a joint in the leg of a Crustacean.

IN an article in the *Revue générale des Sciences* for June 30 and July 15, Dr. Legrand expounds a theory of heredity which he calls "L'emboîtement des Plasmas." He distinguishes in every inheritance between the fixed specific characters and the non-fixed sexual, varietal, atavistic, and parental characters. The fixed hereditary characters have their localisation in the specific cytoplasm, while the chromatin apparatus of the nucleus is the vehicle of the non-fixed characters. The fertilised ovum (or "the original trinitary block") consists of the ovum-cytoplasm with the fixed specific characters (a view for which there is a good deal of experimental evidence) and a nucleus containing the varietal, atavistic, and individual plasmas (respectively maternal and paternal), which the author pictures as segments of a spheroid, overlapping one another (like young leaves in a bud) with the most recent to the interior. According to the particular plan of the bud or *emboîtement*, different nuclear blocks will have different degrees of contact with the cytoplasmic envelope, and this affords a sort of mechanical symbolisation of paternal or maternal preponderance, of latent and patent characters, of male or female sex (which seems to us to get mixed up with paternal and maternal respectively). Dr. Legrand draws ingenious diagrams expressing the results of experiments on the inheritance of coloration in mice, or a familiar case like the hereditary composition of a mule. He seeks to illustrate by a "complex visible" model the "simple invisible" reality. Starting from the meticulous longitudinal splitting of the chromosomes and the orderly movements of karyokinesis, he develops the idea that the cytoplasm supplies the indispensable specific foundation, and that the minor details of the developing edifice are due to the way in which the factors of the non-fixed characters are disposed within the nucleus in relation to one another and to the environing cytoplasm with which there is interaction. To us the theory appears only a diagram: to Dr. Legrand it is much more.

PART 2 of vol. ii. of the Memoirs of the Kyoto University contains an account of the recent measurements made by Messrs. T. Takamine and S. Nitta in the extreme ultra-violet portion of the spark and arc spectra of a number of metals. The sparks were produced by the Hilger apparatus, and the arc in a vacuum lamp, between poles of the metal to be investigated. The spectra were obtained by means of either of two Hilger quartz spectrographs, and were photographed on Schumann plates. The wave-lengths were calculated from the measurements of the plates, the lines of the silver and iron sparks as given by the Blochs being taken as standards. The spark spectra of silver, aluminium, gold, bismuth, cadmium, cobalt, iron, manganese, antimony, and thallium in the region 2000 to 1830 were examined, and a number of new lines found for each element. In the cases of manganese and platinum the whole of the lines are new. The vacuum arc spectra of bismuth, antimony, and thallium gave several new lines in the same region.

IN a paper read before the R. Accad. delle Scienze dell' Istituto di Bologna, in March of this year, Prof. A. Righi returns to the question of magneto-ionisation, already dealt with in previous papers. A beam of X-rays ionises the gas between two metal plates which are suitably connected to an electrometer and an accumulator battery. A magnetic field can be created in a direction parallel to the plane of the plates. Without the latter field the voltage-current curve shows the usual features of a saturated phase followed by one in which ionisation by collision is prominent. When a magnetic field of 430 gausses is super-imposed, there is found a current decrease for the lower voltages, *i.e.* in the earlier portion of the saturated phase, but for voltages of 400 or above the current is slightly increased. This is ascribed by the author to the action of the magnetic field in promoting ionisation. In the opinion of the writer of this note Prof. Righi's interpretation of his results is by no means the only one which is possible, and though his ingenious experiments are of great interest, his theory will need further support before it obtains general acceptance. In particular, it will be necessary to show that the increase of current is not caused by the oblique, and therefore longer paths of the ions under the joint actions of the two fields. When the saturated phase is passed, any increase in the distance travelled over by the negative ions means more opportunities for the production of further ions by collisions, and this may be all that is necessary to explain the results.

IN *La Nature* for August 11 M. Guillaume gives some interesting information concerning the work of the Bureau International des Poids et Mesures, of which institution he is director. As is well known, the Bureau has custody of the primary standards relating to the metric system, *i.e.* length and mass. This involves fairly frequent restandardisations and comparisons of the secondary with the primary standards. The institution also undertakes the verification of the standards of other countries which subscribed to the Convention du Mètre in 1875. Dilatation measurements also play an important part in the operations of the Bureau. Two methods are used, viz. the comparator and dilatometer methods, the former being used for large bars (generally 1 metre in length) and the latter for test-pieces the greatest dimension of which is of the order of 1 cm. These measurements are important, not only because it is necessary to know accurately the dilatation-coefficient of all standards issued from the institute, but also by reason of the fact that such measurements are employed in investigating metals and their alloys. The numerous applications of the nickel-steels for industrial purposes originated at the Bureau. It is interesting to note that most of the geodetic survey standards at present in use in the world have been verified at the Bureau International on a geodetic comparator (or tape bench) erected specially for that purpose. A large universal comparator is in use for determining the values of the various subdivisions of the metre now widely employed, the values being checked to within a few tenths of a micron (0·001 mm.). Reference is made in the article to the important work carried out by Michelson, in collaboration with Benoît, on the measurement of wave-lengths, using a cadmium lamp as standard; and to similar experiments undertaken fifteen years later by Benoît, Fabry, and Perot, which agreed with the results of the earlier investigations to within 1 part in 10,000,000. The use of *invar* (the nickel-steel of very low expansion-coefficient), which was promoted by the researches of the Bureau, has now extended to horology and metrology (bars and tapes) and in other directions.

THE use of alcohol as a fuel in the internal-combustion engine and the possibilities of manufacturing it economically in Australia are discussed by Mr. W. T. Rowe in Bulletin No. 8 of the Department of Chemistry of South Australia. Alcohol has some obvious advantages over petrol, such as its greater safety in storage, freedom from unpleasant smell, and constant composition, but in addition its vapour when mixed with air will stand a much higher compression without pre-ignition. In suitably constructed engines the efficiency per b.h.p. for alcohol is 28 to 31 per cent., as compared with 16 to 20 per cent. for petrol. One of the chief causes militating against the use of alcohol industrially is the restrictions of the revenue authorities, but denatured alcohol would form a good motor spirit provided that methyl alcohol were *not* used as a denaturant. Benzol or petrol is recommended for this purpose. Alcohol can be economically manufactured from substances grown in Australia, and might thus form a valuable industry. The supply of non-utilised molasses in the whole of Australia is insufficient to yield the amount of alcohol equivalent to the petrol imported by South Australia alone; considerably larger quantities of straw are available, however, but its use on a commercial scale has not yet been tried. In South Australia the raw materials offering the greatest promise are wheat, barley, potatoes, straw, and perhaps beet, but, except the straw, these would have to be specially grown to yield enough alcohol to replace the imported petrol. Using wheat or potatoes, the cost of raw material is approximately the same, because, although wheat contains more starch, potatoes give a greater yield per acre; in each case the total cost of the spirit would be from 1*s.* 9*d.* to 3*s.* 6*d.* per gallon, according to the price of the raw materials.

IN the Proceedings of the Tokyo Mathematico-Physical Society, vol. ix. (2) 4, Mr. Hantero Nagaoka obtains equations for evaluating the maximum force between two circular electric currents, and suggests uses for the calculations in connection with electric methods of comparing the intensity of gravity at different places on the earth.

A NOTE on a modification of the epicycloidal method of tracing the profiles of toothed wheels is the subject of a note by Prof. T. Levi Civita in the *Atti e memorie* of the Padua Academy, vol. xxxiii., 11 (Padua: Giov. Batt. Randi, 1917, pp. 8). In it use is made of the "line of action," which is the locus, traced in space, of the point of contact of the wheels as they revolve.

THE catalogue (No. 168) of second-hand books just issued by Messrs. W. Heffer and Sons Ltd., Cam-

bridge, contains particulars of many interesting, and some scarce, works in anthropology, archæology, folklore, mythology, botany, geology, mathematics, astronomy, and physics. We notice in the astronomical section a set of the *Astrophysical Journal*, and the "Nautical Almanac" for 1875–1916.

OUR ASTRONOMICAL COLUMN.

Relativity and Gravitation.—According to the original form of the theory of relativity, an absolute velocity v in space cannot be determined by any physical means, all matter as well as electrical and optical fields being contracted, in the terminology of the older physics, in the same ratio $(1-v^2/c^2)^{\frac{1}{2}}$. Using the same terminology, Einstein's recent gravitational theory requires a gravitational field to suffer contraction in this same ratio, so that an absolute velocity v must remain for ever hidden from our knowledge. Einstein has shown that this theory, suitably generalised to cover independently-moving bodies, leads to changes in the perihelia and eccentricities of the four inner planets which agree well with those observed. In the *Phil. Mag.* for August Sir Oliver Lodge suggests an alternative explanation of the changes in Mercury's orbit. In accordance with pre-relativity theory, the mass of Mercury, when moving with velocity v, is supposed to be $m_0(1-v^2/c^2)^{-\frac{1}{2}}$; of this only the stationary mass m_0 is supposed subject to gravitation, while the sun's gravitational field is not supposed to suffer distortion as it moves through space. The assumed increase in inertia, uncontrolled by gravitation, is found to lead to a revolution of Mercury's orbit in its own plane, which will agree with that observed if the sun has a velocity of about 68 km. a second towards longitude 294°. This velocity would also give an apsidal progression for Mars about equal to that observed, but in the September *Phil. Mag.* Prof. Eddington has shown that it would give orbital distortions for the earth and Venus enormously greater than those observed. In these papers no allowance is made for the distinction between longitudinal and transverse electromagnetic mass, but it seems impossible that this correction could reconcile theory with observation; indeed, the discussion suggests that no theory of the general type suggested by Sir Oliver Lodge can be made to fit all the facts, so that the relativity theory appears to be left in a stronger position than ever.

Photographs of Nebulæ.—A remarkable collection of photographs of nebulæ taken with the 60-in. reflector of the Mt. Wilson Observatory has been published by Mr. F. G. Pease (*Astrophysical Journal*, vol. xlvi., p. 24). The objects selected were in general nebulæ of unknown structure, or nebulæ which were known to exhibit unusual features. Most of the exposures were made with aperture ratio F/5, but several of the bright planetary nebulæ were also photographed with the 80- and 100-ft. focus Cassegrain arrangements of the telescope, in order to give a larger scale. The exposures ranged from ten minutes to seven hours. It is interesting to note that the perfection of the photographs was increased in the case of very long exposures by the use of two guiding stars, which allowed of correction being made for variation in size and for rotation of field produced by refraction and imperfect adjustment of the telescope. In addition to the sixty-five nebulæ which are fully described, attention is directed to others which appeared incidentally on the plates, and to a number of uncatalogued nebulæ and nebulous stars. The photographs show a great amount of intricate detail, and bear witness alike to the excellence of the instrument and the skill of the observer.

The 100-in. Reflector at Mount Wilson.—An illustrated description of the great reflector of the Mount Wilson Observatory is given by Mr. Pease in the *Scientific American* for August 11. As supplementing the account already given in the columns of Nature of July 12 (vol. xcix., p. 385), it may be noted that the moving parts of the telescope, which is mounted on the English pattern, weigh 100 tons. The greater part of the weight is taken up by the mercury flotation system, 40 tons at the north pedestal and 60 tons at the south pedestal. The driving clock is regulated by an isochronous governor of the conical pendulum type, and the weight is wound up automatically at intervals of twelve minutes without interference with the driving. The clock itself stands 6 ft. high and occupies a floor space of 5½ ft. by 4 ft. The actual diameter of the mirror is 101·2 in., and its focal length 507·5 in., giving an aperture ratio of 5·05. Elaborate arrangements have been made to maintain the mirror at constant temperature by water circulation. Manipulation of the dome and telescope involves the use of forty motors of 1/20 to 7½ horse-power, with an aggregate of 50 horse-power and more than thirteen miles of wiring. It is estimated that about 300 million stars will be within range of the new instrument.

INDUSTRIAL FATIGUE.[1]

UNDER the above title Prof. Spooner has collected articles written by him in 1916 for publication in *Co-partnership*. The pamphlet is a useful contribution to the discussion of reconstruction, which already is receiving anxious attention from many who realise its extreme importance and its extreme difficulty.

Evidently in so small a space but few details can be given, but the author has touched upon many points which show how wide is the problem and how great are the difficulties which surround it. Perhaps the main impression left upon the mind after a perusal of these fifty-nine pages is one of the immense amount of scientific investigation which remains to be done before industrial processes—to say nothing of industrial management—can be placed on a thoroughly satisfactory footing. It is only quite recently, and largely on account of present conditions, that the general public and directors of industry have begun to realise that science after all is merely crystallised and systematised knowledge, and that to attempt to conduct industrial processes without it is to dispense with one of the greatest aids to success. Now, however, the leaven is spreading. Many firms operating processes which depend on scientific principles have their own scientific staff working in admirably equipped laboratories, and so far as their own processes are concerned little more is needed, though it would undoubtedly contribute to the general advance if the results of the investigations carried out could be made available for all to profit by. But apart from these questions there are larger problems which affect all industries, and which can only be dealt with effectively by some central authority. Such, for instance, is the question of the number of hours' work per week which will enable an operative to produce the largest output without injurious fatigue. Evidently no general answer can be given to such a question. The answer must vary with conditions, and all conditions must be studied in order that their influence in producing fatigue may be determined. But certain fundamental facts may be established, and perhaps the most im-

1 "Industrial Fatigue in its Relation to Maximum Output." By Henry J. Spooner, C.E. Forewords by Sir Robert Hadfield, F.R.S., and Mr. J. R. Clynes, M.P. (Co-partnership Publishers, Ltd., 6 Bloomsbury Square, W.C.1.) Price 6*d*. net.

portant that has yet emerged is that *output is not necessarily proportional to the hours worked.* The recognition of this fact alone has led to the emancipation of countless victims of long hours, to their lasting benefit, and to the benefit of the factories for which they work. Prof. Spooner points out that conclusions as to overtime and Sunday work, based on accurate scientific investigations, agree with those that managers of industrial works have long known to be more or less true. It is a lamentable result of our inability to take advantage of knowledge lying close to hand that lines of conduct indicated by such conclusions should have been followed by so few. It is nevertheless a distinct gain that the study of industrial fatigue must always in future be recognised as an essential factor in a right determination of the conditions of labour, and that never again will the fortunes of tens of thousands of workers hang entirely upon the will of uninstructed and often unsympathetic employers. Moreover, by placing industry on a scientific basis it will be demonstrated that the interests of master and man are identical, and many of the differences between capital and labour will cease to exist.

There is only space in a short notice to refer to unnecessary fatigue, dilution and subdivision of labour, restriction of output, scientific management, motion-study and time-studies, welfare work, labour turnover, and after-the-war problems, but on all these points Prof. Spooner has something of interest to say. Scientific management, as its name implies, is an application of scientific principles to factory management. Where properly applied there can be no question of its legitimacy, or of its advantages to capitalist and worker, since these are its conditions of success. Unfortunately, it has been sadly misunderstood in this country. Only recently the workers in a large factory, being convinced that it meant more work and less pay, stated emphatically to the writer: "We *will not have* Taylorism here," whilst in the pamphlet before us we find the writer of a foreword describing it as "tending to make the workman into a machine."

The facts of the case are as follows: Some years ago the late Dr. Taylor, struck by the enormous waste of effort involved in industry, took up the study of the subject, and, as a result, introduced his system of scientific management. He recognised that the ordinary comparison of the human body to a steam-engine, whilst possessing elements of truth, was likely to lead to erroneous conclusions, since the conditions of action in the two cases are profoundly different. He showed that in the case of the human body the percentage of the working day for which the muscles could remain under load without undue fatigue was strictly limited, and that this proportion was greatly influenced both by the severity of the labour and by the distribution of the work and rest periods. In such a simple task as the handling of pig iron he showed that a remarkable gain in efficiency could be reached and maintained for long periods by the introduction of appropriate intervals for rest, so that the day's wages could be increased, or, alternatively, the same wages as before could be earned and time saved.

By his lamented death industry was deprived of a great benefactor, but his work remains, and, by great good fortune, his mantle has fallen upon worthy successors. Frank Gilbreth and his co-workers still continue the work, and by the ingenious application of photography to recording movements involved in industrial processes have introduced in "motion-study" a method of investigation of which the effects are only now beginning to be felt. The method aims at recording the movements performed in a given process by learner and by expert. These movements are found to differ chiefly in the direction of a simplification of the movements of the expert, and of a discarding of a number of unnecessary movements observed in the learner. But even in the expert certain unnecessary movements will probably be found, and by the discarding of these also his expertness will be increased, whilst in the case of the learner it becomes possible to arrange a definite course of instruction in the performance of the necessary movements only, which leads at once to great simplification and to the learning of precise series of motions, in place of the old system whereby the learner tried blindly to imitate his teacher. That economy of effort must follow the adoption of such a system is evident, but its results are surprising. Efficiency is very largely increased, and tasks can be performed in far less time than before. The increased efficiency may be used in different ways. It may be used to increase output, but if this be done, labour should share in the increased profit. The increased output may be produced actually more cheaply than the original output, since standing charges should be less in proportion, and therefore the extra output should be profitable to the owners when paid for at old rates. On the other hand, the worker is enabled to turn out more output with the same expenditure of energy and the same amount of fatigue.

Thus the unusual situation arises of the owner being in a position to pay higher wages, whilst the workers do not necessarily demand that payment, since their fatigue and labour are not increased. And yet it is just upon this very point that the ship has split. In some cases, as a result of increased output, rates for piece-work have been "cut"; the workers have resented this, and have adopted the "ca' canny" attitude. The movement has spread, and in many factories the miserable situation has developed of the owners being unable to increase wages because the men will not work honestly, whilst the men will not work honestly because they fear that rates will be "cut."

The other alternative, which in normal times would probably be adopted, largely provides for the maintenance of output at the old level. Since, however, efficiency has increased, this output is now produced in a shorter working day. There remains the time saved, and much of this may legitimately be devoted to bringing into the life of the worker those things which up to now he has lacked. In many industries want of leisure has led to want of health, waning interest, and the impossibility of living a rational life. With leisure, these unfortunate conditions may be changed. A mere reduction of fatigue, if used to increase output, would lead to discontent. But used to increase leisure it may achieve much. For besides the benefits which leisure itself would bring must be considered its effect upon the relations between capital and labour. Capital has no direct interest in the leisure of the worker, though the fact that it is prepared to adopt measures to increase that leisure is itself an indication of a changing attitude. But increased leisure should lead to better education of the worker, and better education will facilitate an appreciation of industrial conditions. Ultimately, it may be hoped, a real understanding between capital and labour may be possible.

It is a calamity that the system which appears to offer the best chance of such an agreement should be so far misunderstood as to be described as an attempt to drive the worker.

Prof. Spooner may be congratulated upon having done something to clear away this misunderstanding. His pamphlet is a valuable contribution to the question of industrial fatigue. A. F. STANLEY KENT.

THE FOREST DEPARTMENT OF INDIA.

THE Government of India has issued a pamphlet of sixty-five pages, entitled "The Work of the Forest Department of India," by Mr. R. S. Troup. This gives in popular form, and at the low price of 5*d*., an account of the forests of India, and of the methods by which they are protected and managed. The Forest Department controls one-fifth of the total area of India, viz. 249,867 square miles; but no fewer than 141,882 square miles of this are so-called "unclassed" forests, where control is nominal, being restricted to the collection of revenue. Of the "reserved" and "protected" forests, 107,985 square miles in area, about one-half, 55,629 square miles, are scientifically managed and subject to sanctioned working plans. The most important commercial forests are the teak forests of Burma, the sal forests of Northern, Central, and North-Eastern India, and the deodar and pine forests of the North-Western Himalaya. Forests yielding inferior kinds of timber are scarcely less important, as they provide wood, fuel, fodder, and other produce for the surrounding agricultural population. The *personnel* of the Forest Department includes 237 officers trained in England, 231 officers recruited in India and trained at Dehra Dun, and a subordinate service of 1610 rangers, 2000 foresters, and 10,500 forest guards. The Forest Research Institute of Dehra Dun, which was founded in 1906, prosecutes investigations in sylviculture, forest botany, economic products, zoology, and chemistry, and has already issued a considerable output of scientific literature. The pamphlet contains a valuable list, with short descriptions of the forty-four most important forest trees, and an excellent chapter on minor produce, which includes bamboos, grasses, fibres, oil seeds, tanning materials, essential oils, oleo-resins, gums, india-rubber, drugs and spices, and animal products like lac, silk, horns, hides, and ivory. An interesting account is also given of various forest industries which have been established by the Forest Department, such as the tapping of *Pinus longifolia* for resin and turpentine, which has now passed out of the experimental stage, the annual collection amounting to 2592 tons. The paper-pulp industry, the manufacture of matches, the antiseptic treatment of timber, and the dry distillation of wood are industries which appear to be capable of considerable development in India.

THE GREAT ERUPTION OF SAKURA-JIMA.

PROF. F. OMORI, the well-known director of the Seismological Institute of Tokyo, has recently issued a third valuable memoir on the great eruption of the Sakura-jima on January 12, 1914 (Bull. Imp. Earthq. Inv. Com., vol. viii., December, 1916, pp. 181–321). The first two memoirs have already been noticed in NATURE (vol. xciv., p. 289, 1914, and vol. xcviii., p. 57, 1916). The third memoir is principally concerned with details which, though of great value, are unsuitable for reproduction in a note. Two or three points, however, are of general interest. On and around the plateau of Hakamagoshi, which projects from the west side of the island, there are unmistakable signs of the generation of volcanic blasts. The school-house was entirely destroyed and carried away. On a farm near the top of the plateau a great number of large mandarin-orange trees were uprooted and carried some distance up a slope. The blasts were directed principally against the north-east corner of Hakamagoshi and the neighbouring village of Koike. The destruction here was general, and the tree-trunks were mostly overthrown or broken between two directions which, when produced backwards, passed through the highest and lowest of the western series of craterlets. On the east side of the island no distinct trace of the blast could be detected. Before the eruption the island was separated from the mainland on the east side by the Seto Strait, which, in its narrowest portion (400 metres in width), varied in depth from 29 to 40 fathoms. The lava entered the strait on the morning of January 13, blocked it up after sixteen days, and finally rose in height to about 54 metres above the sea. The movement of the lava stream on this side ceased with the close of 1914. About three months later there took place a second outflow of lava, not directly from the craterlets, but from the southern face of the south-eastern lava-field. The new outflows expanded into a form like that of a chrysanthemum leaf, the greatest elongation amounting to nearly 900 metres.

Prof. Bundjiro Kotō has published (Journal of the College of Science, Tokyo, vol. xxxviii., art. 3, December 25, 1916) a comprehensive and handsomely illustrated account of the same eruption. The author reached the city of Kagoshima on January 15, 1914, and saw the great lava-sheets flowing from the volcanic island, a most unusual spectacle among the explosive volcanoes of Japan. The tremendous "Strombolian" outburst of January 12, when the fragmental matter rose as a great cloud-pillar to a height of more than 18,000 metres, is shown in the photographic frontispiece, which forms a most memorable addition to our historic pictures of volcanoes. The inhabitants of the island were rescued in boats by volunteers from the shore of Kyûshû, and traversed a pumice-laden sea. The ejected materials, which are described in petrographic detail, consist of femic augite-andesite. There is evidence in the scorched trees of a *nuée ardente*, like those of Martinique, which spread down the western slope on the early morning of January 13. Among the ejecta are many resembling porcelain, and composed of cordierite, plagioclase, and glass. This type has been described from Asama-yama, and Prof. Kotō now styles it ceramicite.

THE DISSEMINATION OF FUNGUS DISEASES.

VERY little has been heard of the International Phytopathological Convention of Rome since the outbreak of hostilities, but there is little doubt that the subject will be revived when terms of peace are settled or shortly afterwards. A careful consideration of its proposals is, therefore, all the more necessary at the present time, and the reasoned criticism published by Dr. E. T. Butler, the Imperial Mycologist, in vol. ix., No. 1, of the Memoirs of the Department of Agriculture in India, on the dissemination of parasitic fungi and international legislation is doubly welcome from both the scientific and the administrative points of view.

Dr. Butler discusses, in the first place, the various methods by which such fungi may be conveyed over great distances, and decides that little is to be feared from natural means, the chief agent being civilised man engaged in commerce. He then recounts some of the attempts that have been made to control the spread of plant diseases by legislation, and criticises the procedure proposed by the Rome Convention, chiefly, of course, with reference to the conditions under which India is situated.

The weak points in the Convention, especially those caused by the loose phraseology of the much-debated Article 5, are duly pointed out, but Dr. Butler concludes with the opinion that, subject to certain necessary amendments, and if certain clauses are broadly interpreted, there are obvious advantages in adhering to it, and that "after a few years' experience, and as soon

as other countries have established the organisation required if they wish to adhere, there seems to be a good prospect of a much more efficient control of the dissemination of the fungus diseases to distant countries than has ever been thought possible in the past."

The memoir contains an appendix giving a brief history of the spread of most of the important cryptogamic diseases of cultivated plants, the extension of which has attracted notice during the past seventy years.

PARIS ACADEMY OF SCIENCES.

BONAPARTE FUND.

THE committee has considered twenty applications for grants from the Bonaparte Fund. It is considered desirable to reserve the greater part of the annual income until after the conclusion of the war and to defer grants for the purchase of apparatus. The grants recommended and approved by the Academy are

(1) 2000 francs to Edmond Bordage, for the publication of his histological researches on the metamorphoses of insects.

(2) 2000 francs to E. Chauvenet, for the continuation of his researches on zirconium.

(3) 2000 francs to Gustave Dollfus, for the continuation of his studies on the Paris basin.

(4) 2000 francs to Henri Froidevaux, for the production of a catalogue of the periodicals, more than eight hundred in number, in the library of the Société de Géographie.

(5) 2000 francs to Emile Gadeceau, for his studies on the submerged forests of Belle-Ile-en-Mer.

(6) 2000 francs to F. Gagnepain, for assistance in the publication of an etymological dictionary of botanical genera, with illustrations.

(7) 2000 francs to L. Joubin, for pursuing at Messina the researches he has undertaken on the deep-sea Cephalopods.

(8) 2000 francs to W. Kilian, for the pursuit of his studies and his publications on the fossil fauna and the stratigraphy of the south-east of France.

Including the balance from 1916 (55,000 francs), the amount in hand is 105,000 francs, and the balance carried forward, after paying the above-named grants, is 89,000 francs.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE American Philosophical Society held a very successful meeting in Philadelphia on April 12–14. The address of welcome was delivered by the president, Dr. W. W. Keen, who, with Vice-Presidents W. B. Scott and G. E. Hale, and with Dr. A. A. Michelson, presided. More than forty papers were presented. The national crisis also received some attention, Dr. M. T. Bogert, of Columbia University, outlining the work chemists may do to aid the National Research Council in the solution of certain war problems. Suitable badges to identify "members of the industrial army" so that they may not be called slackers was urged. Attention was directed to England's mistake in permitting general enlistment for "the front" when in many cases men with special ability could have been of much more value using their brains in the laboratory. A well-trained industrial army is just as important as the army of fighters.

A brief outline of the effect of different lighting conditions on the eye and the factors which cause the eye to lose in efficiency and to experience discomfort was given by Dr. C. E. Ferree, of Bryn Mawr College. More than forty different lighting conditions have been investigated, and many experiments conducted pertaining to the hygienic use of the eye. The loss of efficiency sustained by the eye in an unfavourable lighting situation seems to be muscular, not retinal. The retina has been found to lose little, if any, more in functional activity under one than under another of the lighting systems employed. The observation of motion pictures for two or more hours causes the eye to lose heavily in efficiency. The loss decreases rather regularly with increase of distance from the projection screen. It seems little, if any, greater, however, than the loss caused by an equal period of steady reading under much of the artificial lighting in actual use. In all the lighting situations tested a close correlation was found to obtain between the loss in power to sustain clear seeing and the tendency to produce ocular discomfort.

A spectroscopic method of deriving the absolute magnitudes of stars, and a new formula connecting parallax and proper motion for studying the relationship between the motion of stars and their true or absolute magnitudes, were described by Dr. W. S. Adams, of Mount Wilson Observatory. About one thousand stars have been used in the investigation, and the results establish almost certainly a definite increase in velocity with decrease in brightness.

The skeleton of a gigantic extinct bird found last summer in the Bighorn basin of Wyoming by an expedition from the American Museum of Natural History was described by Dr. W. D. Matthew, one of the curators. It is of the Lower Eocene age, a contemporary of the little four-toed horse, the fossil remains of which are found in the same region. The bird was about as large as the extinct moas of New Zealand, much bulkier than any living bird, although not so tall as an ostrich. It stood nearly 7 ft. high. The head was enormous, 18 in. long with huge compressed beak like the extinct Phororhachos of Patagonia, but unlike any living bird. The neck, too, was very massive and rather short, and it was quite unable to fly, the wings being about as large as in the cassowary. Although it resembled the modern ostrich group in some ways, it was not related to them, and only remotely related to any other known birds, the nearest perhaps being the seriema of South America. A few fragments of this gigantic bird were found by the late Prof. Cope more than forty years ago, and named Diatryma, but it remained practically unknown until the discovery of this nearly complete skeleton. A description of this specimen by W. D. Matthew and Walter Granger, with photographs and a reconstruction, will appear in the Bulletin of the American Museum.

In a paper by E. S. Botch, of Philadelphia, the present status of our knowledge about early man in America was summed up as follows. Man lived during at least a part of the Pleistocene period for tens of thousands of years south of the Glacial moraines. He probably went through an Eolithic period, and certainly through a Chelleen period in some places, and therefore was truly a Palæolithic man. He may have shown rudimentary fine art. Palæolithic American man was the ancestor of the Neolithic historic Indian, and although less advanced in culture, much like his descendant in anthropological characteristics. Whether he was an autochthon in America or whether he came from some other place, and, if so, when, we do not as yet know positively, although his affiliations seem to be to the west. And it is to four men above all others that we owe our knowledge: Abbott, the discoverer of Palæolithic implements and horizons; Volk, the corroborator; Lund, the first finder of probably Palæolithic bones; and Winchell, the investigator of patination.

A valuable paper describing the factors influencing the sex ratio in poultry was read by Dr. Raymond Pearl, of the Maine Agricultural Station. In the present war conditions any information which would make it possible for the poultryman or farmer to produce a larger number of pullets to lay eggs, without producing so many cockerels to eat up costly food, would be of very great value. This study, which is based on eight years' experiments and more than 22,000 individuals, demonstrates, first, that the determination of sex in poultry is primarily a matter of a definite, hereditary mechanism, just as it is in insects and other forms which have been studied. At the same time, it is demonstrated, however, that in certain physiological circumstances the operation of this mechanism may be modified in such a way as to lead to the production of more females in proportion to the number of males. The chief factor in bringing about the modification in the direction of a larger production of females is the fecundity of laying ability of the hens used as breeders. The larger the number of eggs which a hen lays before being put into the breeding pen, the larger will be the proportion of females and the smaller the proportion of males produced by her eggs. Some years ago it was shown by the speaker that the ability to lay eggs (fecundity) in poultry is a matter of definite Mendelian inheritance. As a result of this knowledge, it is possible to breed strains of hens in which productivity is a definitely fixed characteristic. The present results, taken in connection with the earlier ones, show that when the poultryman breeds along the right lines for increased egg production, he will at the same time be producing a strain in which profit-making pullets preponderate in place of the less profitable cockerels.

The session on Saturday afternoon (April 14) was set apart for a special symposium on aeronautics, the speakers including Dr. A. G. Webster, of Clark University, a member of the Naval Advisory Board, and Dr. W. F. Durand, chairman of the National Advisory Committee for Aeronautics.

On Friday evening (April 13) a reception was held in the hall of the Historical Society of Pennsylvania, when Prof. G. E. Hale, director of the Solar Observatory at Mount Wilson, California, gave a most interesting address on "The Work of the Mount Wilson Observatory."

A very pleasant feature of the Saturday afternoon session was the presentation of a portrait of Dr. I. Minis Hays, dean of the Wistar Association, by Joseph G. Rosengarten, LL.D., on behalf of the association, on the centennial anniversary of its organisation, and in the twenty-first year of Dr. Hays's secretaryship of the American Philosophical Society.

ARTHUR W. GOODSPEED.

EXPERIMENTAL WORK IN AERONAUTICS.[1]

THE report to Parliament of the Advisory Committee for Aeronautics for 1916–17 has just been issued, and is a further vindication of the foresight shown when this committee was inaugurated in 1909 under the presidency of Lord Rayleigh. Since that time funds have been continuously placed at the disposal of the Royal Society for the development of the experimental investigations at the National Physical Laboratory, the aeronautical work of which in all its branches is controlled by the Advisory Committee for Aeronautics.

Although less directly responsible to the Advisory Committee than the National Physical Laboratory, the Royal Aircraft Factory carries on its experimental work in close co-operation, as does also the Meteorological Office in its aeronautical work. Other institutions and private bodies find the Advisory Committee for Aeronautics a suitable body to receive and review their communications.

In normal times approved reports and papers are collected annually into a technical report issued for sale, but for obvious reasons publication has not taken place since the opening of hostilities. The volume of material collected is now very large, and special arrangements have been made to render it available to British designers, to whom it is of incalculable value. As the brief report now issued appears to have been framed to give as much information as is permissible and is of very general interest, it is reproduced below almost in full.

The experimental investigations carried out under the control of the Advisory Committee for Aeronautics into the many problems affecting the development of aircraft have been continued and extended during the past year.

Owing to the growth of the work of the committee in certain directions, sub-committees have been formed to advise in regard to special matters. An Internal-Combustion Engine Sub-Committee has been appointed under the chairmanship of Dr. Dugald Clerk, while Mr. H. Fowler is chairman of a Light Alloys Sub-Committee. Other sub-committees have been constituted from time to time to investigate particular problems.

Many changes and developments in the design and construction of aircraft have taken place as the result of the continued and varied experience gained from their use in warfare under modern conditions. An increasing number of special problems is thus constantly presented for investigation, and these have very closely occupied throughout the year the attention of the staffs engaged in experimental work, both at the National Physical Laboratory and at the Royal Aircraft Factory. In addition to aerodynamical research, much attention has been given to questions relating to engines, materials of construction, strength of construction and design, instruments and accessories, as well as to methods of attack from aircraft, and other matters.

Equipment for Experimental Work at the National Physical Laboratory.—Reference was made in the report for last year to the additional equipment provided for experimental work. The wind channels now available comprise two 7-ft. channels, two 4-ft., and one 3-ft. The new 7-ft. channel was completed and brought into use early in the year 1916–17. No important departure has been made in its design from that of the earlier 7-ft. channel, but some minor modifications have been introduced which experience had indicated as tending to greater convenience in working. An air-speed of 85 ft. per second can be reached in this channel with an expenditure of 160 h.p. It is doubtful whether further increase in size of channel or in speed of air-current would advance existing knowledge to an extent sufficient to outweigh the greatly increased cost and other disadvantages involved. If it should prove necessary, for certain purposes, to conduct experiments on a larger scale and at higher speeds, it would appear, therefore, to be necessary to employ a method in which the model is moved through the air. As is well known, this procedure presents various difficulties, and the securing of even moderately accurate data in this manner is, at the best, extremely laborious. Probably the least troublesome way of applying this method is by installing measuring apparatus on the aeroplane itself, and it seems probable that only in this way can an

[1] Report of the Advisory Committee for Aeronautics for the Year 1916–17. (Cd. 8629.) (London: H.M. Stationery Office.) Price 1d. net.

accurate comparison be obtained between model and full-scale conditions. The matter is of importance, and attention is being given, so far as existing circumstances permit, to the devising of suitable measuring apparatus.

Improved methods of supporting the models under test in the channel have been devised for use in special cases. The effect on the measured resistance of the method of holding the model is often surprisingly large, and without the necessary care and experience in avoiding effects due to interference with the airflow, very large errors may result. The difficulty is, of course, in general greatest in measurements on forms of small head-resistance, *e.g.* aeroplane bodies and airship envelopes. Earlier measurements on airship models of stream-line shape were made to determine the form of least resistance, and were, in the main, comparative; from the cause mentioned, it is probable that little reliance can be placed on the absolute values then obtained. With the new methods of support the possible error has been greatly reduced, and when full-scale values have been determined with accuracy, the prediction of full-scale resistance from the model experiments will be established on a satisfactory basis. The new method of support is employed also in tests of models of complete aeroplanes.

Experimental Work in Aerodynamics.—It is not proposed at present to enter in detail into the consideration of questions on which experiment has been in progress. Flyers and designers have, of course, given close attention to matters in which improvement would be of value, and this has led to the repetition and re-examination, from a somewhat modified aspect, of many earlier investigations. The experiments have been of very varied character, and have included tests of models of, probably, all types of aircraft at present employed. A large part of the work has arisen from specific inquiries proceeding from the service departments, but progress has been made with some investigations of more general character.

A number of experiments have been carried out relative to the resistance of airship shapes, and further observations on the distribution of pressure in such cases have been made.

The investigation into the stability of the aeroplane has been continued. A number of special cases have been examined, and results of importance have been reached. The theory of airship stability has also been investigated.

Research into the nature of the flow of fluids round obstacles has been continued.

A number of investigations relating to airscrews have been carried out with the view of increasing the accuracy of prediction of performance, and thus facilitating the design of airscrews for special purposes. Tests on screws to be used as windmills for the production of power have also been made.

The work has included a complete series of tests on more than one complete aeroplane model. The information thus derived is of considerable importance for practical purposes in aeroplane design.

Strength of Construction.—A number of questions relating to strength of construction have been investigated, and some general conclusions have been reached tending to simplification of strength calculations. The basis to be adopted in design to secure adequate strength in high-speed machines, with the power of rapid manœuvring essential in aerial fighting, is a matter demanding the most careful consideration. To secure the highest possible speed it is necessary to keep down the weight to a minimum, and the best compromise between these two opposed conditions does not admit of precise determination. This question has received attention, and the manner in which strength varies with increase of dimensions has also been made the subject of investigation. Cases in which vibration has been set up have been examined, and calculations relating to the strength of the body structure have been made.

Engines.—A number of questions relating to engines and engine design have been submitted by the Air Board for consideration by the Engine Sub-Committee. These have required very careful investigation, and the sub-committee has been closely occupied since its formation with the various problems which have arisen. Experimental work has been carried out, by request of the sub-committee, at the Royal Aircraft Factory; and the sub-committee has received much assistance in the examination of special questions, both from the Royal Aircraft Factory and from manufacturing firms the works of which have been visited.

An extensive series of experiments on radiators has been carried out at the National Physical Laboratory, and other investigations relative to the transfer of heat from surfaces to fluids flowing over them are in progress. These have an immediate bearing on the design of the cooling systems in aeroplane engines. Experiments relating to the performance and efficiency of magnetos have also been made.

Light Alloys.—The use of light alloys in the construction of aircraft and aircraft engines is becoming of rapidly increasing importance, and improvements in the production of light alloys will have great effect on future development. The investigations relating to light alloys which have been in progress for many years at the National Physical Laboratory have been continued, and results of special interest have been achieved during the past year. Suggestions have been made to the Air Board by the committee which may, it is hoped, help to secure the best conditions in manufacture for the development of such alloys. The formation of the Light Alloys Sub-Committee will be of great assistance in co-ordinating the work on light alloys which is being done in various quarters, and in collecting the information resulting from experimental investigation and manufacturing experience. Experimental work has been carried out for the sub-committee at the Royal Aircraft Factory, the University of Birmingham, the National Physical Laboratory, and elsewhere, and arrangements have been made for placing the information obtained at the disposal of manufacturers.

Fabrics, Dopes, etc.—A number of special questions have arisen for investigation in relation to airship and aeroplane fabrics. A large amount of attention has been given to materials for use as dopes, varnishes, etc., and the Laboratory has collaborated with the Military Air Department in an investigation into the behaviour of fabrics, dopes, and protective coatings under the conditions of tropical exposure. The results of exposure to ultra-violet radiation have been studied in relation to the effect of sunlight, and conclusions of importance have been reached. The committee is indebted to Dr. Shakespear, of the University of Birmingham, for information he has placed before them as to the methods developed by him for determining the permeability of fabrics by hydrogen; comparisons have been made with the results obtained at the National Physical Laboratory. Methods of determining the purity of hydrogen have been investigated.

Investigations Relating to Seaplanes.—Tests on models of seaplane floats in the William Froude National Tank have been continued and extended. The provision made last year for an increase in the staff available for carrying out this work has enabled more rapid advance to be made, and a number of important questions have received attention. The methods employed have been improved and elaborated, and new apparatus has been designed whereby addi-

tional measurements can be obtained and further information secured relative to special conditions arising in practice.

Special Matters.—As usual, a large number of special questions have been referred to the committee for advice or investigation. The experiments relating to bombs have been continued, and valuable communications relative to the flight of bombs have been received from the Air Department of the Admiralty and from the Central Flying School. The committee is indebted to Prof. Karl Pearson, F.R.S., for communicating to it the results of his calculations of bomb trajectories. This question has also been the subject of investigation at the National Physical Laboratory.

Questions relating to the attack of aircraft from aircraft have been examined. Problems in connection with the aeroplane compass have been further considered. Other instruments and apparatus for use on aircraft have been investigated.

As previously, a number of inquiries have been received from the Board of Invention and Research and the Munitions Inventions Department, and investigations have been carried out at their request at the National Physical Laboratory and at the Royal Aircraft Factory.

Reports from the Experimental Stations of the Air Services.—A number of communications have been received during the year relating to experimental work carried out by the R.N.A.S., and by the Testing Squadron of the Royal Flying Corps. Many of these have been of great interest and value, and of much assistance in the application of the results obtained from the model experiments and in the estimation of aeroplane performance.

The committee visited on various occasions during the year military and naval air stations, as well as the Royal Aircraft Factory and the National Physical Laboratory, and witnessed many interesting experiments and trial flights.

EXPERIMENTAL WORK AT THE ROYAL AIRCRAFT FACTORY.—*Engine Experiments.*—Much research has been made into various methods for improving the output and the trustworthiness of aeroplane engines. A large number of radiators of various types have been tested, and an efficient type has been standardised. Great progress has been made in the development of the air-cooled engine. Work has been done on the compensation of carburettors for variation of air density, and a device for improving the performance of engines at great heights has been tested on several engines.

Full-Scale Aeroplane Experiments.—The measurement of the resistance of aeroplanes in flight has been continued with the object of confirming the model experiments, and an instrument for measuring the resistance directly has been developed. The distribution of air-pressure over the surface of the wing of an aeroplane in flight has been measured, and further experiments on these lines are in progress. Experiments have been made on longitudinal and lateral stability of aeroplanes in flight, and much theoretical work on the same subjects has been done. Measurements have also been made of the disturbance of the air behind a propeller to obtain data which are required in the design of new machines.

Instruments.—The behaviour of various types of magnetic compass in an aeroplane in flight has been investigated. Two new types of bombsight have been developed, and are now being tested. The improvement of the standard aeroplane instruments has been continued, and a number of special instruments have been devised for use in connection with full-scale experiments on aeroplanes. The means of communication between pilot and observer have been improved.

Fabrics, Dopes, etc.—Weathering tests on fabrics and experiments on the influence of humidity on their strength have been made. The development of a calendered fabric has received attention. The deteriorating effect of various agents (bacteria, light, etc.) has formed the subject of considerable research. The experiments on the composition of dopes, varnishes, and pigments, and on fluxes, paints, and oils have been continued.

Light Alloys.—Much experimental work has been done to arrive at the most suitable aluminium alloys for engine parts. Experiments have also been carried out in the application of the alloys which have been developed at the National Physical Laboratory.

METEOROLOGICAL WORK.—Experimental work in meteorology has been mainly in connection with the inquiry into the location of distant thunderstorms and the tracing of their progress across the map by means of a properly organised system of observations at various stations.

On some occasions the progression of thunderstorms across the map has been satisfactorily identified, although the identification on other occasions was uncertain.

Further attention is necessary in order to develop an apparatus which is more directly suitable for the purpose than that which is at present in use, in consequence of the variability of the sensitiveness, which with the present form of apparatus is unavoidable.

In addition, an inquiry into the variation of the gustiness of wind between day and night has been provided for by the erection of an anemometer with its vane at 140 ft. above the ground.

Observations have also been made of the variation of the wind with height close to the ground; and a large number of observations of pilot-balloons have been made and duly reported.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn that Dr. W. C. M'Intosh, professor of natural history in the University of St. Andrews since 1882, is about to retire from the position, in consequence of advanced years and conditions of health.

MR. W. BREW, hitherto lecturer in electrical engineering at the Belfast Municipal Technical Institute, has been appointed head of the electrical department of the Birmingham Municipal Technical School.

ACCORDING to the *Aftonbladet*, special lectures are to be given during the coming winter at Greifswald University on "Germany's Commercial Relations with Scandinavia," and a chair of the Swedish language is to be founded in the University after the war.

THE new session of the Sir John Cass Technical Institute commences on September 24. The syllabuses of classes which have reached us show that special courses of higher technological instruction in connection with the fermentation industries have been arranged; instruction will be given in brewing and malting, and in the microbiology of the fermentation industries. The methods of differential and integral calculus and their application to chemical and physical problems will be studied in the department of physics and mathematics. Courses of an advanced character will be provided in the metallurgy department on gold, silver, and allied metals, and on the heat treatment of metals and alloys. The courses of instruction are for the most part designed to supply a technical training for persons engaged in chemical, metallurgical, and electrical industries, and in trades connected with them. A number of the more specialised courses of instruction which in former years formed a characteristic of the work of the institute have for the present been discontinued.

TECHNICAL schools and colleges are now issuing particulars of the courses of study they have arranged for the forthcoming winter session, and we have received a number of college calendars and prospectuses from various districts. At the Battersea Polytechnic, in the Technical College for Day Students, the usual courses are offered in mechanical, civil, electrical, and motor engineering, building science, and applied chemistry. In addition, new courses have been arranged in gas engineering and manufacture, and in the technique of paper-making. The polytechnic is continuing its special war work, which includes classes for the training of men and women munition workers, courses for women in engineering tracing, and free instruction for disabled soldiers and sailors in motor-car engineering, electrical testing, sanitary inspectors' duties, and other forms of remunerative work. The City of Bradford Technical College offers a complete training for the various branches of the textile, chemical, and engineering industries, including the underlying sciences. The diploma courses extend over three, or in some cases four, years, and occupy the full time of the student, much of whose work is of an advanced character. A special characteristic of the courses is the great importance attached to scientific research. At the West of Scotland Agricultural College, Glasgow, students are provided with facilities for the study of agriculture, dairying, forestry, horticulture, and poultry-keeping. Some of the courses have been arranged in conjunction with the University of Glasgow, and under conditions explained in the prospectus students may qualify for the B.Sc. degree in agriculture of the University.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 27.—M. Ed. Perrier in the chair.—A. **Lacroix**: The composition and modes of alteration of the ophites of the Pyrenees.—G. **Humbert**: Some properties of binary indefinite quadratic forms.—H. **Deslandres**: Contribution to the supposed influence of the cannonade on the fall of rain. The opinion of M. C. Saint-Saëns.—A. **Laveran**: The experimental inoculation of *Leishmania tropica* in apes: multiplication of the primary lesions by auto-inoculations in a *Circopithecus mona*: Paul **Sabatier** and G. **Gaudion**: The various modes of decomposition of amines by catalysis: return to aniline and the substituted anilines. Examples are given of the various types of decomposition effected by metallic nickel, removal of hydrogen, separation of ammonia, and separation of aromatic amine.—F. **Delhaye** and **Sluys**: The formation of the Karoo in the western Congo.—MM. **Lapicque** and **Legendre**: The improvement of war bread by neutralisation of the ferments of the bran. An extraction of 85 per cent. of the wheat gives a flour containing such a proportion of bran that the bread made from it is unpleasant in taste and rapidly goes mouldy. The addition of a proportion of lime water in making the bread neutralises the acidity of the bran and gives a bread which has a better taste and keeps longer than bread made from the same flour without the addition of lime water.

BOOKS RECEIVED.

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. iv. No. 1, Echinoderma. Part 1. Actinogonidiata. By Prof. F. J. Bell. Pp. 10+plates. (London: British Museum (Natural History) and others.) 2*s*. 6*d*.

Transactions of the Royal Society of Edinburgh. Vol. li. Part iv. Sessions 1915–16–17. (Edinburgh: R. Grant and Son.) 31*s*. 6*d*.

Jacob and the Mandrakes. By Sir J. G. Frazer. Pp. 23. (London: H. Milford.) 2*s*. 6*d*. net.

Primitive Man. By Prof. G. Elliot Smith. Pp. 50. (London: H. Milford.) 3*s*. 6*d*. net.

Shells as Evidence of the Migrations of Early Culture. By J. W. Jackson. Pp. xxviii+216. (Manchester: At the University Press; London: Longmans and Co.) 6*s*. net.

Our Analytical Chemistry and its Future. By Dr. W. F. Hillebrand. Pp. 36. (New York: Columbia University Press; London: H. Milford.) 1*s*. 6*d*. net.

Thomas A. Edison. Pp. 216+plates 8. (London: G. G. Harrap and Co.) 3*s*. 6*d*. net.

Thrice through the Dark Continent. By Prof. J. Du Plessis. Pp. viii+350+map and illustrations. (London: Longmans and Co.) 14*s*. net.

Founder's Day in War Time: An Address delivered on March 23, 1917, at a Memorial Service for Members of Manchester University who have Fallen in the War. By Sir A. W. Ward. Pp. 55. (Manchester: At the University Press; London: Longmans and Co.) 1*s*. 6*d*. net.

Carnegie Endowment for International Peace. Year Book for 1917. Pp. xvii+213. (Washington.)

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CHINSURA

THURSDAY, SEPTEMBER 20, 1917.

THE PUBLIC SCHOOLS AND NATIONAL SUPREMACY.

The Public-School System in relation to the Coming Conflict for National Supremacy. By V. Seymour Bryant. Pp. xviii+78. (London: Longmans, Green, and Co., 1917.) Price 1s. 6d. net.

THE author has done useful service in writing this little volume. It contains a large amount of valuable information, while, of course, it raises a host of controversial points. His statement in the preface that "in the struggle for national supremacy education is the vital factor" will be disputed by few. It is when he comes to laying down the lines on which a reformed curriculum for both the preparatory and the public schools should be constructed that the whole of the forces of conservatism represented by the existing system will unite in a stubborn resistance.

A point Mr. Bryant makes early in the introduction consists in directing attention to the fact, familiar enough to those conversant with the educational world, though generally unappreciated by the public, that the headmasters of our great public schools are, practically without exception, classical scholars. Of the 114 schools represented in the Headmasters' Conference, ninety-two have classical headmasters, ten mathematical, seven jointly mathematical and scientific, four scientific, and one historical. And from the published numbers of boys in the schools 82 per cent. are under classical domination, while only 7½ per cent. are in schools where the head has any academic qualifications in science whatever.

This fact alone is sufficient to explain most of the difficulties encountered in all attempts to obtain more time and attention for natural science studies.

Every Englishman is proud to acknowledge the splendid spirit shown by all the public schools and their boys in connection with the war. It may be true that this is attributable to the conditions of life in the public schools, which favour the development of fine character. The amount of direct evidence for this conclusion is, however, very small, and it may be asked whether, after all, it is not something deep down in the English nature which is the real explanation of these things. Otherwise, how do we account for all the V.C.'s and other distinctions which rightly decorate so many of our brave fellows who have not had the advantage of a public-school education? The fact is sufficient that the boys from the public schools have made a fine show and have quitted themselves like men. But this does not abolish the other fact that the great majority of them when they leave school are very ignorant. How many can speak any language but their own? How many are really familiar with the great classics in their mother tongue? How many clergymen, whose office it is to search the Scriptures daily, are capable of studying the Gospels in the original Greek? Our Ministers and heads of Government departments have been almost to a man trained in the great public schools, but this has not saved them from the grossest kind of mistake in referring to common materials and processes of manufacture.

The public-school system of to-day, which is so largely due to Dr. Arnold at Rugby, owes all its best results to the principle of self-government by the boys themselves. The teaching in every subject and in every respect has improved since his time, but is still open to serious criticism. John Stuart Mill states somewhere that "the source of everything respectable in man is that his errors are corrigible," and that is all that can be said of the teaching in the public schools at this day. It is the prejudice of the headmasters and of the literary members of the staff which in most cases prevents that complete recasting of the time-table which alone will bring satisfaction to those who are interested in the use of scientific method and the sufficient teaching of natural and experimental science. Among other obstacles in the way of reform the author mentions examinations and the subordination of curricula to their requirements, the difficulty of obtaining properly qualified teachers, and the financial waste under the house system. With regard to the last point a great deal might be said. The fault lies primarily with the British parent, who is not willing to pay an adequate fee for his boy's education, but is ready to meet the charges of a comparatively expensive and unnecessarily luxurious kind of hotel. The true duties of a schoolmaster are so important that his pay and prospects ought to be both liberal and secure. But to give him a salary on which he cannot keep a wife and family in comfort and to allow him to compensate himself out of the profits of hotel-keeping is to adopt a system not far removed in principle from that of the Turkish Government, which pays no salaries, but allows extortion and pillage.

W. A. T.

USEFUL MATHEMATICS.

(1) *Commercial Arithmetic and Accounts.* By A. Risdon Palmer and J. Stephenson. Part i. Pp. xvi+292+lvi. (1908.) Part ii. Pp. xii+293–514+lvii–cliv. (n.d.) (London: G. Bell and Sons, Ltd.) Price 2s. 6d. each part.

(2) *Arithmetic for Engineers, including Simple Algebra, Mensuration, Logarithms, Graphs, and the Slide Rule.* By C. B. Clapham. Pp. xii+436. (London: Chapman and Hall, Ltd., 1916.) Price 5s. 6d. net.

(3) *Practical Mathematics for Technical Students.* Part ii. By T. S. Usherwood and C. J. A. Trimble. Pp. x+565. (London: Macmillan and Co., Ltd., 1916.) Price 7s. 6d. net.

(1) "THE present treatise on commercial arithmetic and accounts has been written to meet the needs of that great and ever-increasing army of students which is receiving a thorough commercial training in our modern

schools and colleges before entering upon a business career."

Such is the claim put forward by Messrs. Palmer and Stephenson in their preface. But there is a very large other class of pupil for whom it is growing daily more and more necessary to study books of this kind. We refer to the great army of students who do *not* receive a thorough commercial training in our modern schools and who do *not* contemplate entering upon a business career.

The game of keeping boys and girls shut up in stuffy rooms memorising things that will be of no use whatever to them in actual life, simply in order that they may score marks by copying them out in an examination-room, has been carried too far in the past, and we hope that one effect of the war will be to consign to the rubbish heap a large proportion of the waste luxuries of our present academic educational systems, and to replace them by subjects better calculated to develop national efficiency. A sound and thorough training in the principles of business and finance should not be the monopoly of a privileged class of pupils who enter special courses, but should be made available, and indeed compulsory, for every boy and girl who attends a secondary school, and may then go on to the university.

The present book contains exactly the kind of arithmetic which is required by everyone who hopes to earn money or to invest it and receive the interest, and who is compelled to pay rates and taxes. Everything is of the most practical nature possible. There are, in the two parts, sixteen facsimile illustrations of such things as cheques, stock and share certificates, poor-rate demands, receipts and the like, and the only thing wanted to make the collection complete is an income-tax form, which is what probably gives the average citizen more trouble than all the rest put together. But the subject-matter is by no means limited to questions of finance. Elementary mensuration is treated in great detail and applied to doors and windows, dust-bins, flower borders, bookcases, radiators, and other articles. Contracted multiplication and division are well done, although we regret that the authors do not explain how far the processes may be carried with approximate data. The authors also make every effort to introduce into the examples statistics relating to the trade and commerce of the British Empire. Moreover, the book is written in an interesting and stimulating style. Even at the very beginning we have a brief account of the methods of counting and numeration of early history and of savage tribes. It almost makes one wish one were a modern child, so that one could be educated on such a book instead of on the old useless drudgery of algebra and Latin and Greek genders.

When the book goes into a new edition we should ask the authors carefully to consider whether it would not be useful to introduce sections dealing with logarithms and the slide rules. There is unfortunately a widespread superstition among mathematical ignoramuses that it is necessary to repeat some nonsense about indices to every pupil before teaching him the simple rule that to multiply two numbers together you simply have to add their logarithms, but, judging from the present book, Messrs. Palmer and Stephenson appear quite capable of making the subject independent of this silly prejudice.

The insistence on rough checks in arithmetical work is very important, especially in view of the tendency among examination candidates to throw away 100 marks which they might have saved by checking one question in order to scrimmage five marks by starting another. The task of gathering together such enlightening collections of examples as are here found must have been very laborious, and we are surprised not to find Government examinations enumerated among the sources from which they are drawn.

(2) All science students, and, indeed, most other people, require some kind of training in the meaning, use, formulation, evaluation, and interpretation of algebraic formulæ, and their inverse uses involving the solution of equations. This is not the same thing as the addition, subtraction, multiplication, and division of the collections of dry bones hitherto described as "algebra," for the victims of that kind of drudgery often say they never knew these things had any use or meaning. A very fair introduction to what is required may be obtained by taking Mr. Clapham's "Arithmetic for Engineers" and turning to chaps. iii., iv., and v., which deal respectively with "Symbols and their Uses," "Simple Equations," and "Transposition of Formulæ." Here, then, is another instance in which class-distinctions require to be broken down, and the mathematical instruction drawn up for engineering students thrown open to the rank and file of the pupils of our schools and colleges. For nearly twenty years the writer of this review has persistently advocated that algebra should be taught through the *use of formulae*, such as area = length × breadth, the converse use or inversion of the formula leading to the problem of solution of equations, as when the area and breadth are given and the length is the unknown quantity. Although such a method is contemplated in a recent syllabus issued by the Civil Service Commission, Mr. Clapham is the first, or nearly the first, writer to develop this very simple and obvious method consistently. His method of treatment should even suffice to dispel the doubts which a beginner might experience as to the sanity of the mathematicians who use ab to denote the result of multiplying, instead of adding, a and b. Not only is the notation carefully explained, but multiplication and division formulæ take precedence, both in the text and examples, over those involving addition and subtraction, and the practical illustrations show that in dealing with concrete quantities brevity is often of more use in writing products than sums.

The two previous chapters deal with "Vulgar Fractions" and "Decimal Fractions" respectively. Here, again, we are glad to see insistence placed on *rough* checks and approximations, but at the same time the author, by his objection

(p. 50) to contracted methods, leaves the door open for the perpetration of unmathematical inaccuracies in the evaluation of results from approximate data. Thus, in the example on p. 50:—

```
  1670
   2·75
  ─────
  8350
 11690
 3340

 4592·50
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the final ·50 are wrong, because 0 and two blanks do not make 0, nor do 5 and 0 and one blank make 5. We do not know what these blanks are, and there is no justification for writing down ·50 as the result of addition of these incomplete columns. If we remember that 2·75 really may mean anything between 2·745 and 2·7549 it will readily be seen that the inaccuracies go further. Of course, if all the data are given and results required to three significant figures, the rule given on p. 50 is applicable, but a lot of superfluous figures will be written down and incorrectly added. Again, on p. 55 (Ex. 46: Divide 231·4 by 1·938) the author puts a lot of zeros at the end of the dividend and also carries down a lot of digits, although there are blank spaces requiring filling above them.

The rest of the book deals with logarithms, mensuration, the slide rule, and graphs. This is all useful and practical work, which may very well be taught to students other than engineers, perhaps with some reduction of the number of examples in mensuration. The majority of the "graphs" considered connect magnitudes of different kinds. Where this is not the case (as in equations of straight lines) we are glad to see that the author *does* represent the variables in their correct relative proportions, instead of perpetrating the distorted figures in which straight lines do not cut at the correct angle.

(3) For those who want the sort of thing that is contained in Part ii. of Messrs. Usherwood and Trimble's "Practical Mathematics," that book undoubtedly provides just the sort of thing they want. It is not the kind of book one altogether likes, and we could not recommend it to students of the academic type, except an occasional candidate reading for the B.Sc. degree in physics without taking mathematics as well. Undoubtedly vector analysis, advanced calculus and differential equations, Fourier's series, and inverted delta (∇) are required by engineering students, and if they can get all this and a little thermodynamics in a book of this size, they will not quarrel about rigorous demonstrations. The result is, however, a formidable mass of symbols and formulæ. Individually, we consider that the binomial, exponential, and hyperbolic functions should not be taught until after the elements of the calculus have been mastered; however, it is quite easy to begin at chap. vi. and take some of the earlier parts afterwards. The attempt to prove the differentiation formula for the sine savours too much of the "we see" or "we may put" of the typical narrow-minded mathematician. On the other hand, in dealing with symbolical notation, the authors make some effort to keep out of the pitfall into which Edwards plunged when he applied to inverse operations formulæ which he had proved only for direct ones. The introduction of thermodynamics in §51 enables the authors to teach some very important theorems in partial differentiation which the average academical student overlooks in his rush and hurry to satisfy the demands of the external examiner.

The examples are distinctly good, and this feature will undoubtedly appeal to teachers of pure as well as applied science.

At the end there is the usual collection of tables, with the usual superfluous duplication of logarithms and antilogarithms, squares and square roots, sines and cosines, and the usual shortcomings in the absence of tables of logarithms of reciprocals, and in the fact that the tables of squares do not give correct results when applied to the squares of integers.

G. H. B.

OUR BOOKSHELF.

Steam Turbines. By J. A. Moyer. Third edition, revised and enlarged. Pp. xi+468. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 16*s.* 6*d.* net.

THIS book was first published in 1908; the additions made in the present edition have been mainly in the line of new applications. The book opens with some historical descriptions, followed by a brief section dealing with the elementary theory of heat, including explanations of entropy diagrams. The following chapters take up the design of nozzles and blades, and descriptions of commercial types of turbines.

The treatment of low-pressure, mixed pressure, bleeder, and marine turbines occupies separate chapters. Of these, the section dealing with the marine turbine is least satisfactory; the author's bias towards certain types is apparent here and elsewhere in the volume. Thus no mention is made of the Ljungström turbine, despite its importance, and in the marine section justice is not done to types of reduction gear other than the Westinghouse floating-frame type. Hydraulic transmission is not mentioned, and electrical transmission is dismissed in a few inadequate lines. There is a chapter on steam turbine economics giving information on cost of plant, maintenance and running; this information is of interest and is frequently omitted in British textbooks. Other chapters deal with stresses in rings, drums, etc., and include a few words on the critical speeds of loaded shafts. In describing testing arrangements, power is to be measured by Prony or water brake, or by electrical appliances; shaft-horse-power of marine turbines and its measurement by torsion-meter are not treated. Another chapter gives some information regarding the gas turbine, and might well have been omitted.

The volume has been used as a text-book in the United States, but we do not think that there is any danger of its displacing British text-books in our own colleges. An appendix contains some exercises to be worked by the student, and there are others interpolated in the text and not always easy to find.

Handbook for Rangers and Woodsmen. By J. L. B. Taylor. Pp. ix+420. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 11*s.* 6*d.* net.

THIS is a handbook of pocket size, primarily intended as a vade-mecum on all subjects that may turn up in the course of the multifarious activities of the forest ranger or woodsman in the United States. It contains much information that is only indirectly connected with forestry, and will be useful to travellers and settlers generally in the wilder parts of North America.

The first part, entitled "Equipment," deals with clothing, harness, and provisions. The next part is a guide to the construction of telephone lines, paths, roads, bridges, buildings, and fences, and treats, in addition, of blasting, concrete work, painting, and carpentry. The part called "General Field Work" begins with riding, pack animals, and waggons, and concludes with useful notes on felling timber, fighting forest fires, land-surveying, and field cooking. The next part is concerned with the care of horses, cattle, sheep, and swine, and gives an interesting description of the various methods of identification of stock by branding, ear-marks, etc., and of the curious dodges resorted to by cattle-thieves. Another part deals mainly with human ailments and injuries, reptiles, camp sites, and finding one's way. It is here stated that two species of ant in Arizona and New Mexico throw up mounds, and in nearly every instance leave an opening at the south-east side, presumably in order that the morning sun may warm the runway sooner.

The appendix contains many useful lists and tables, and concludes with a glossary of peculiar words in use in the Far West. The book is clearly printed on strong thin paper, and is illustrated with 243 appropriate figures and diagrams.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Audibility of Distant Gunfire.

THE sound of gunfire from northern France might be expected to be audible in Cambridge, for on the occasion of Queen Victoria's funeral the firing at Portsmouth was clearly heard in this neighbourhood, and even further north, near Peterborough, and the distance from the battlefield is not much greater than that from Portsmouth. But I did not become aware of the sound until one day early in May last, when several volleys of guns were audible about midday. The sound was unmistakable for me, as I had heard the Queen Victoria funeral guns at a distance of sixty miles (in Surrey), and thus recognised the phenomenon at once. These particular volleys may have come from a little skirmish at sea, or even from gun practice at Shoeburyness, for I heard no more for several days. However, they led me to listen carefully, and on the very still nights at the end of May I began to hear the gunfire from the battlefield. It was audible only on the south-east side of my house, and there chiefly in a re-entrant angle of the walls.

I soon found (at the beginning of June) that the sound was astonishingly intensified in a garden latrine, which acted as a resonator like Mr. Carus-Wilson's garage (NATURE, September 6, p. 6), although it is but a tiny building, and differs in being built of brick and having a slate roof. Here the explosions were nearly as loud and frequent as I afterwards heard them in Kent. I compared the intensity of the sounds as heard at different windows of my house, and found it greatest at the basement, but only on the south-east side of the house. I could not detect the sounds in a north-east basement room, so apparently the vibrations did not come through the earth. During June and July the explosions became ever more audible, until about July 29 they were evident even indoors at midday, above the murmur of distant traffic. Since the middle of August they have become less distinct and fewer, and now I can hear either none, or perhaps a few faint booms now and then. The sounds have been heard by other persons in and around Cambridge, especially in the villages, and I am informed that they have been detected so far north as Downham Market, in Norfolk.

In July I spent a few days in Kent, visiting in quick succession Rochester, Maidstone, Ashford, Lydd, Tenterden, and Tunbridge Wells. I was unable to detect the sounds at Lydd. They were faint at Ashford and Tenterden, clear at Maidstone, more so at Rochester, and especially distinct at Tunbridge Wells, where they were audible through all street traffic. The spot where the sounds were most intense was the rocky combe at Rusthall, where the hollow, bounded by more or less perpendicular escarpments of rock, acted as a potent resonator.

It is notable that Lydd is on the plain near the sea, Maidstone, Ashford, and Tenterden on the undulating Weald, and Rochester on a north-west slope of the Downs; also that the Tunbridge Wells valley descends to the west, and the Rusthall valley to the north-west. Thus in those places where the sounds were most distinct the vibrations had travelled over high ground and arrived in a descending direction. There was no doubt as to the direction whence the sounds came. Wherever the sounds were audible on open ground, in Kent or in Cambridgeshire, one could discern that they came from the south-eastern horizon, and through the air.

F. J. ALLEN.

Cambridge, September 15.

Unusual Rainbows.

WITH reference to my letter in NATURE of August 30 on the subject of "An Unusual Rainbow," and to the replies which were given on September 6, I should like to mention that the sun's altitude and the angle at which the primary bow met the reflected bow were only rough estimations. At the time when the phenomenon was visible I had unfortunately no instruments at hand. Since then I have calculated the altitude of the sun from a knowledge of the ship's position and the sun's declination and hour angle, and have found it to be about 8° 5′. This gives the angle of intersection of the bows as 24¼° approximately, which is more in agreement with my estimation. The surface

of the sea was remarkably calm at the time, and this no doubt accounts for the brilliancy of the bows, which are due to the reflected image of the sun.

I wish to thank the readers of NATURE who have given explanations of the phenomenon, and to say that these explanations have been much appreciated by my brother officers and myself. ALLAN J. LOW.

September 10.

The Convolvulus Hawk-Moth.

AN unusual number of the convolvulus hawk-moth has been noticed in this neighbourhood during the last month, and I venture to ask if a similar occurrence has come to light in other localities. The record, which is by no means exhaustive, extends chiefly some thirty miles along the coast, though some specimens have been captured twenty miles inland. It would be of interest to know whether this is an immigration from overseas or whether any of your entomological readers can advance a reason for their appearance.

C. E. ROBSON.

Hancock Museum, Barras Bridge, Newcastle-upon-Tyne, September 14.

EXAMINATIONS IN SECONDARY SCHOOLS.

THE valuable Report published in 1911 of the Consultative Committee, of which the Right Hon. A. H. D. Acland was chairman, appointed by the Board of Education to consider the subject of examinations in secondary schools has borne tentative fruit in a series of regulations set forth in a circular of the Board, No. 996, dated May 25. This has now been given practical effect in the appointment of a Secondary-School Examinations Council, with the Rev. Wm. Temple, formerly headmaster of Repton School, as chairman (see p. 58). The council is comprised of representatives of the universities, of the Teachers' Registration Council, of the Association of Education Committees, of the various examination boards, and of the County Councils and Municipal Corporations Associations, but it contains no names *directly* representative of either boys' or girls' secondary schools, or of the Associations of Headmasters and Headmistresses concerned with them, or that of a single headmaster. This fact tends to deprive the Examinations Council of much weight, and of that direct personal association with the problems of secondary-school life which the occasion demands; and it would have been desirable also to include, especially in the present changed outlook and temper of employers, representatives of the great industrial organisations of the country. For some unexplained reasons the provision for nomination by a standing committee of professional bodies has been withdrawn after consultation with them.

It may be remembered that the report of the Consultative Committee reviewed in detail the origin and development of the multiplicity of external examinations of which the secondary schools in England are the subject, including the examinations of such bodies as the College of Preceptors, the Oxford Delegacy, the Cambridge Syndicate, the Public Services, the London and Provincial Universities, and the numerous professions which demand special entrance examinations. It discussed the evil effects of all these diverse examinations on the work and *moral* of the secondary schools, preventing them from realising their true purpose, and instituting aims other than those of the efficient education and training of their pupils. It showed how, for example, the universities and the professions are to some extent defeating their own ends by their demands upon the schools and by their conflicting requirements, reducing the time available for methodical instruction and training, and leading to too early technical training, which lowers the value of the finished product of the school as a whole. Striking figures were given showing the number of pupils who passed to the universities from 371 secondary schools the subject of full inspection by the Board during the school years 1907-8 and 1908-9. Out of 14,789 pupils who left these schools during those two years, only 400 went to the universities, or 2·7 per cent.

A full consideration of all aspects of the question led the committee to the conclusion that, whilst external examinations were necessary and desirable in secondary schools, they must be brought under better regulations, reduced very largely in number, and intimately connected with a well-considered and adaptable scheme of inspection, so as to ensure a sound basis of liberal education free from specialisation. The report suggested that an examination should be instituted for the award of a secondary-school certificate, with due regard to the pupil's school record, open to candidates who have reached a class the average age of which is sixteen, and who have been in attendance at a secondary school for at least three years, and that the only other external examination should be one suitable to the attainments, general and special, of pupils of an average age of eighteen or nineteen in respect of whom a secondary-school higher certificate would be awarded.

These examinations, closely linked with inspection, it was suggested, should be organised by the Board of Education acting through an Examinations Council, which would include representatives of the universities, the professions, the local authorities, the teachers in different types of schools, and other persons with practical experience of industrial and commercial life, as well as of the official experience of the Board itself. It should be entrusted with the necessary powers to carry out the main principles laid down in the report.

In the concluding sentence of the report reference was made to the fact that seven years previously to its issue in 1911, namely, in 1904, this subject of the examinations in secondary schools had been referred to a like Consultative Committee and recommendations made, the main proposals of which were never embodied in practical action, and the committee plaintively urged that it could not contemplate the recurrence of such an unsatisfactory state of things, and

trusted that the Board would see that the necessary reforms were carried out; yet nearly six years have elapsed since this second report was published before anything in the nature of effective measures is taken, due, doubtless, to the energy and enterprise which Mr. Fisher is bringing to his arduous task. It is true that in July, 1914, a circular was issued, No. 849, giving effect to many of the recommendations of the Consultative Committee and inviting criticism and suggestions thereon, but leaving the important matter of finance undecided. The Board, however, announced in a later circular, No. 933, issued in December, 1915, that, in view of the situation caused by the war, its proposals embodied in Circular 849, in so far as they would involve expenditure by the Board, must remain in abeyance, which meant the virtual withdrawal of the proposals for reform.

Recently, however, under the ægis of the present President of the Board of Education, we have the issue of Circular 996, in which the Board definitely stated that it would bring into actual operation, with due financial arrangements, its scheme of July, 1914, Circular 894, on August 1, and that from that date the Board would undertake the functions and responsibilities of a co-ordinating authority for secondary-school examinations with the assistance of a body of persons to be called "The Secondary-School Examinations Council." The circular stated that the council would be comprised of nine representatives of the various university examining boards, four of the local authorities, four of the Teachers' Registration Council, and one of the standing committee which, it was proposed, should be formed from the various professional bodies, with a suggestion that the number might be increased by representatives of other standing committees, such as the chambers of commerce, interested in the council's work. The Board itself will be represented at the council meetings by such of its officers as it may choose to appoint to attend as assessors, who will have the right to speak, but not to vote.

This circular marks an important step in the endeavour to bring order into the chaos which now besets and gravely hinders the work of the secondary school in respect of the numerous and often conflicting external examinations to which its pupils are subject in the endeavour to proceed to the further studies for which it is the necessary preparation, and in so far as it succeeds in this it is a step to be commended. It is now generally accepted by those competent to judge and by all but interested persons and bodies that the proper work of the secondary school is to promote upon the basis of liberal studies the formation of character, the development of the imagination, and the due training of the intellectual faculties. The new Advisory Council does not appoint its own chairman, who is the nominee of the Board. Clauses 7 and 8 define the responsibilities and functions of the council, and give power to the officers of the Board who attend its meetings to require when they think fit that questions of principle or policy shall be referred to the Board.

The importance of this Advisory Council would appear to indicate that the representation of the universities should have been direct and not through the medium of their examination boards, and it would appear that neither in the case of the professional bodies concerned nor in that of the teachers is the representation adequate to the important interests involved. Surely so grave and dignified a body should have been left free to nominate its own chairman with the approval of the Board. The constitution of the new committee would appear to make it largely subservient to the Board and to deprive it of that independent character which the importance of its responsibilities demands.

It is surely worthy of consideration whether the time has not arrived with regard to the secondary schools, of which more than 1000 are approved as efficient by the Board, for a further step to be taken, thoroughly safeguarded by a sound and effective system of inspection, which would have the important effect of tending to extend the school life, now lamentably low, and raising the quality of the instruction. We refer to the introduction of the principle, first, that the school should be recognised by the university within the area of which it is situated as fully complying with a recognised standard as to its staffing, equipment, and the duration and quality of its courses of study; and, secondly, that the scholars passing satisfactorily through its courses year by year shall at the close of the final year be entitled to a certificate and be qualified to proceed to higher and more specialised studies in any university of the United Kingdom in any of its faculties, and shall also be eligible for entrance to the examinations leading up to membership of the various professional bodies and societies.

LOCUSTS.[1]

THE International Institute of Agriculture, Rome, has issued a memoir summarising published and communicated information relating to locusts; this has been compiled by Prof. Trinchieri, not only from literature, but also from information obtained by direct inquiry from countries adhering to the institute. The memoir will be valuable to all who have to do with fighting locusts, and the information collected is put in a form readily accessible and easily consulted. One criticism is possible, and it is one important to working entomologists: the term "sauterelles," or "locusts," has not been clearly defined to mean species that have the habit of migrating in swarms only; and while some countries have included non-swarming "grasshoppers" (*e.g.* all the Phasgonuridæ), others have deliberately omitted all but the real "swarm-migrating" locusts. There are probably not more than six-

[1] "La Lutte contre les Sauterelles dans les divers Pays." (Rome Institut International d'Agriculture, 1916.)

teen species of "locust" on the earth, but the memoir lists 112 of the family Acridiidæ (called Locustidæ). Allowing for this, the memoir provides an excellent summary of habits, life-histories, remedies, and international co-operation.

It is curious that human ingenuity has not succeeded in controlling locusts, or even in understanding why an insect, normally widespread in small numbers, becomes enormously abundant, packs into swarms, and migrates over really enormous distances. One reason is that no single observer in his lifetime can get a long enough experience to be able to estimate the value of the different factors that govern these outbreaks; they are probably so diverse that a very minute knowledge of local conditions is required, and in any one locality there may not be sufficient outbreaks during a single working lifetime. So we still know very little of the conditions producing outbreaks, or the means of anticipating them and preparing for them. The methods in use are most diverse and as a rule extremely simple. In India troops have been turned out to fire volleys of blank cartridge to divert a swarm; while in Morocco cultures of *Coccobacillus acridiorum* have been used with success. These two represent the extremes of simplicity and of scientific achievement; but a perusal of this memoir shows that the locust problem still remains and looks like doing so. As the author says, "Il existe toujours une question des sauterelles," and in the main the pest must be fought in every country with simple, homely methods devised to suit the local circumstances: the arsenic-treacle method succeeds in South Africa, but not in India; the method of "mopping up" hoppers in Bombay with a bamboo frame and bag is useless elsewhere; and there is no one method that stands out definitely as likely to be valuable.

To the economic entomologist, who is probably a member of an agricultural department, locusts present a serious problem, calling for whatever ingenuity he possesses. In 1903 there broke out in Bombay a plague of locusts of unknown habits, which actually flew about for eight months before laying eggs, and then suddenly the entomologist was called on for a means of dealing with hoppers about to hatch from eggs laid over 150,000 square miles of country. Such occasions are crises in the life of the entomologist, and we commend Prof. Trinchieri's summary as a welcome source of inspiration when faced with an outbreak.

In his last section the author discusses shortly the value of international co-operation, a matter that has been prominent since the Phytopathological Conference was held in Rome. Sixteen countries have answered in the affirmative the institute's query as to their willingness to co-operate against locusts. The value of such co-operation lies in the intelligence mutually given as to the occurrence of locusts, and this would be most valuable. It is useless discussing this at present. Locusts do not respect international boundaries or join the Entente; but it is a part of the valuable work done by the institute that we should have these memoirs and be prepared for international co-operation when other circumstances render it possible. H. M.-L.

BIRD MIGRATION IN CENTRAL SWITZERLAND IN RELATION TO METEOROLOGICAL CONDITIONS.[1]

THE relation of bird migration to meteorological conditions has been considered, of late years, an important part of the study of the movements of birds, and various theories have been advanced to explain their interrelations. In the memoir before us Dr. Bretscher deals very fully with the arrival in spring and departure in autumn of the summer visitors to Central Switzerland. In relation to these he treats of bird migration and atmospheric pressure, wind, atmospheric precipitation, temperature, etc., and under each heading he has tables of statistics in support of the statements in the text. By tables 1 and 15 he shows that the position of barometric depressions within the area has, as we should expect, no influence on the arrival of the summer migrants and their departure in autumn. In tables 3 and 4 he discusses the influence of direction and strength of the wind, and concludes that, in Central Switzerland, migration proceeds irrespective of the direction of the wind, and that, unless the force be so great as to be a hindrance, the influence of this, too, may be regarded as a negligible quantity. The fourth section deals with atmospheric precipitation in relation to bird migration; as the author tells us in Switzerland even keen ornithologists stay at home in wet weather, we are not surprised to find that they have few direct records of migration in rain, snow, or fog, and he himself says, further observations on this subjeet are wanted.

What strikes one as being the most interesting of any of the sections are those on spring and autumn migration in relation to temperature. Dr. Bretscher gives many interesting tables showing the number of observations on the movements of each species under each degree of temperature Centigrade. These indicate the maximum and minimum between which migration takes place, the gradual increase to the most favourable migration temperature, and the decrease after this is reached. Here we see that birds migrate between certain temperatures, which vary according to the species; thus, the blackbird and song-thrush perform their migrations at a lower temperature than the insect-eating warblers. Another aspect is presented on table 9, namely, the duration of the migration period in relation to the average temperature, and the author here comes to the conclusion that the two are not correlated; thus the warmest average temperature does not necessarily coincide with the shortest

[1] "Der Vogelzug im schweizerischen Mittelland in seinem Zusammenhang mit den Witterungsverhältnissen." Von Dr. K. Bretscher. Nouveaux mémoires de la Société Helvétique des Sciences naturelles, vol. li., mém. 2.

migration period, nor does a cold spell mean a lengthening of the time over which the migration extends. Table 10 shows the difference of temperature of the migration day and that directly preceding it, and purports to prove that it is the temperature of the moment, not that which went before, which incites birds to migrate. It seems, however, as if the author had somewhat confused the issue; it cannot be the temperature at the point of arrival which incites the bird to begin its migration in spring. After this we have the various migration dates compared for Switzerland, Hungary, Bavaria, and Württemberg, though as the last has only three entries we think it might have been omitted.

In conclusion, the author indicates his conviction, which is probably shared by most ornithologists, that the real incentive to migration is not to be found in outward circumstances, but must be sought in physiological conditions. The outward conditions, including food, do undoubtedly have some effect upon it, but do not produce the necessary impulse. Though there is perhaps nothing startlingly new in this pamphlet, yet it is a welcome addition to the literature relating to migration; it shows much careful work, and the fact that Dr. Bretscher refrains from drawing more than very tentative conclusions adds to, rather than detracts from, its value. He realises that it is not possible to come to any definite solution of the problem he is studying without observations—and, we would add, meteorological data—made over a much wider field.

W. E. C.

CONTRIBUTIONS TO EMBRYOLOGY.[1]

NO money given by Mr. Carnegie for the furtherance of scientific research is likely to yield better interest than that invested in the Department of Embryology in the Carnegie Institution of Washington, D.C. The nucleus of the department was formed by the collection of human embryos assembled by Prof. Mall when he held the chair of anatomy in Johns Hopkins University, Baltimore. It took Prof. Mall ten years to collect his first hundred specimens; five years to collect the second hundred; three years for the third; and two years for the fourth hundred. Since his collection was taken over by the Carnegie Institution four hundred specimens have been gathered each year. The collection of material is now the most extensive and the equipment the best of any embryological department in the world. Specimens are being gathered from all parts for the study of "racial embryology"—an untouched field of research. New technical procedures are being introduced to enable workers to reconstruct the different parts of the embryo with much greater accuracy than had been previously possible.

The two volumes here noticed contain an account of recent researches carried out by workers attached to the department of which Prof. Mall is the director. The director himself contributes two papers—one on the origin of the "magma reticule," which is present in normal embryos, but is particularly abundant, as Giacomini had noted, in pathological human embryos. His second paper is a description of the condition of cyclops as seen in early stages of human development. Mr. R. S. Cunningham describes the development of lymphatics in the lung—a paper which is interesting not only from a theoretical, but also from a practical point of view. Dr. Florence Sabin gives an account of a prolonged series of investigations concerning the origin of blood-vessels, and reaches some unexpected conclusions regarding the earliest blood channels which appear in the head and brain. Certain channels which at first serve as veins appear afterwards to be converted into arteries.

All the papers represent a high grade of workmanship, and no pains or expense have been spared to obtain accuracy and finish of illustration.

A. K.

[1] "Contributions to Embryology." Vols. iv. and vi. (Carnegie Institution of Washington, 1916-17.)

NOTES.

THE succession of M. Painlevé to the Premiership of the French Government ought, even in this country, to excite the interest and friendly sympathy of the scientific world. The new Premier is a member of the Paris Academy of Sciences, and a mathematician of world-wide reputation; besides contributing to the literature of his subject, he has held, until quite lately, two of the most important mathematical chairs in France. To construct a similar case in our own country, we should have to suppose our Prime Minister to be a man like the late H. J. S. Smith, or Sir William Ramsay; could anything more improbable be thought of? Yet the evidence is steadily growing that men of the so-called professorial type may show themselves eminently capable of directing public affairs; President Wilson is a conspicuous example, and as time goes on the number of such cases is certain to increase. We feel that, on behalf of English men of science, we may congratulate, not only M. Painlevé, but even France herself, on this appointment; and we confidently hope that the sequel will justify it, and help to make average citizens understand the value, in *all* national affairs, of a strictly scientific habit of mind.

UNDER the heading of "New German Chemical Discoveries," the *Times* of September 14 quotes from the *Neue Zürcher Zeitung* a review of German activities in technical matters in the field of war economics. It is stated that by the use of liquid sulphur dioxide viscous golden-yellow mineral oils are being extracted from coal; the yield, however, is small, 5 kilos. per metric ton. This is equivalent to about 1¼ gallons per imperial ton, and is a striking commentary on the shortage of such oils in Germany. The refining of petroleum oils by this solvent had already been placed upon a commercial footing under the Edeleanu patents, but the outbreak of the war interrupted the development of the process, which depends on the preferential solvent action of the liquefied gas on certain classes of hydrocarbons and sulphur compounds, enabling the removal of those which give rise to a smoky flame, together with the objectionable sulphur compounds. In a series of Howard lectures (Roy. Soc. Arts, 1916) Prof. Brame suggested the use of this solvent as being the most promising for the extraction of certain constituents of coal in future investigations; it is therefore of some interest to find that commercial application of liquid sulphur dioxide is now yielding these hydro-

carbon oils. A further quotation refers to the production of liquid hydrocarbons from naphthalene by heating under pressure with aluminium chloride. There is little novelty in this, for aluminium chloride has been very largely resorted to in the chemistry of hydrocarbon oils. It is stated also that a process has been discovered by which nearly twice the usual amount of ozokerite can be obtained from lignite distillation, but no indication of the method is given.

THE Deputy-Controller for Auxiliary Shipbuilding, Admiralty, has appointed Lt.-Col. J. Mitchell Moncrieff to be Director of Engineering Work, to deal generally with all civil engineering matters which may arise in connection with his department.

THE Board of Agriculture and Fisheries directs the attention of English nurserymen and other persons to the regulations issued by the Government of the Dominion of Canada which prohibit the importation of all five-leaved species of the genus Pinus, and also all species and varieties of currants and gooseberries into Canada. The importation of all pines and ribes (currants and gooseberries) into the United States of America has already been prohibited.

THE American Museum of Natural History has received a telegram from Mr. Donald B. MacMillan, leader of the Crocker Land Expedition, in which he gives an account of the latest discoveries made by his party. He defines the position of two new islands, and reports important surveys of the coast of Ellesmere Land. Two islands described by earlier expeditions cannot now be found in the positions marked on the charts. There has been discovered an enormous glacier, second only in size to the Humboldt. Mr. MacMillan has named it the American Museum Glacier.

THE seventieth birthday of Prof. S. Hoogewerff, formerly rector of the Technical High School of Delft, was recently celebrated by his friends and pupils. Prof. Holleman briefly reviewed Hoogewerff's work, carried out conjointly with the late Dr. Van Dorp, on the cinchona alkaloids, on *iso*quinoline, and on the production of anthranilic acid from phthalimide. The latter reaction became a step in the manufacture of synthetic indigo. On behalf of a number of Dutch chemical firms, Dr. Van Linge, manager of the Maarssen quinine works, announced that more than 8000*l*. had been subscribed for the foundation of a prize for chemistry at the Technical High School at Delft, in order to commemorate Prof. Hoogewerff's services to this institution and to Dutch chemical industry.

MR. HODGE, Minister of Pensions, stated to a deputation received by him on Monday that he proposed to take immediate steps to seek the necessary funds for the establishment of a National Experimental Laboratory which might ultimately become a national factory for manufacturing limbs. For the present, however, he was opposed to the establishment of a national factory. It was, in his view, essential that the Committee of Management of the National Laboratory should be small, representative of surgeons and mechanical experts, and distinct from any committee managing hospitals for limbless men. The Laboratory Committee would be directly responsible to the Ministry of Pensions, and would be empowered to ensure that the improvements which they recommended should at once be introduced into the manufacture of artificial limbs.

THE Indian Government is often called on to do curious pieces of work in connection with its policy of toleration towards the myriad religions of the Empire. The route to the sacred temple at Badarinath, in the Lower Himalaya, has from time immemorial attracted large bodies of pilgrims. It starts from Hardwar, where the Ganges emerges from the hills into the plains, and is 338 miles in length. The route is also valuable, as it attracts a considerable trade from Gartok over the Niti Pass. The road was so dangerous, partly owing to damage suffered in the great flood caused by the rupture of the dam of the Gohna lake in 1894, that serious loss of life was annually reported. The Indian Government has now intervened, and by a grant from public funds, aided by a subscription from a Hindu merchant of Calcutta, this famous route has been realigned, improved, and provided with iron bridges to replace the former dangerous structures of bamboo ropes. The road is now open for pony traffic, and the new regulations secure the comfort of the pilgrims and proper sanitation.

IN the *Fortnightly Review* for September Viscount Bryce discusses a list of fourteen persons on whom the epithet "great" is usually conferred. He points out that there has been an element of chance in the bestowal of this title; some were second-rate men, and a good many of first rank have not received it. It has been bestowed on men of action rather than on men of thought, and no Shakespeare, Dante, Socrates, Bacon, Kant, Newton, or Leibniz appears in the list. All, except two Popes, have been rulers or conquerors; and moral excellence, nobility of soul, or devotion to duty has had little to do with the conferment of the honour of greatness. "To have founded a nation, as did Washington, to have saved a nation from disruption, as did Lincoln—these are achievements which make renown immortal. The epithet has ceased to be attached to famous names since the death of the last who received it—Frederick William of Prussia. But had it been given to any since his day, none would have deserved it better than these two, George Washington and Abraham Lincoln."

THE *Psychological Bulletin* (vol. xiv., No. 7) gives an account of the problems incident to the war which are of a psychological nature, and outlines the steps taken by a special committee in the United States to assist the military authorities with these problems. Problems suggested by military officers are referred by the committee to appropriate individuals or institutions for immediate attention, and the chief psychological laboratories of the country have been offered for such use as the military situation dictates. It is proposed to appoint a committee on psychology for the National Research Council, while special committees are to be organised to deal with various important aspects of the relations of psychology to the war, *e.g.* the psychological examining of recruits, the selection of men for tasks requiring special skill, psychological problems of aviation, problems of shock, re-education and vocational training, problems of recreation in the Army and Navy, problems of emotional stability, fear and self-control, acoustic and visual problems of military importance. It will be seen that the list is comprehensive, and it is asserted that already a new method of selecting officers devised by a psychologist is in use in many of the officers training camps. It is no longer a problem of inducing the American military authorities to accept methods of psychological measurement, but primarily one of meeting their expressed needs and requests for assistance.

ONE of the remaining unknown regions in tropical Africa was explored in 1915, when Major Cuthbert Christy made a journey along the Nile-Congo watershed on behalf of the Sudan Sleeping Sickness Commission. Major Christy contributes a paper on the subject, accompanied by a new map, to the *Geograph-*

ical Journal for September (vol. l., No. 3). From the Lado Enclave north-westward to about lat. 7° N. the divide proves to be a continuous and more or less level strip of high country, covered with open savanna and in places as much as two miles in width. The fact that it is level and continuous makes this watershed important as a possible railway route, provided only that the unexplored northern part proves to have the same nature as the southern part. There is an ample water supply and plenty of good timber along the route. Major Christy suggests that a line should be built from El Fasher in Darfur, to which the Khartoum-El Obeid line is now being extended, along the Congo-Nile watershed to the Nile at Redjaf or Wadelai, and thence by the rift valley to Lake Tanganyika. This would be a longer but more practical route between Egypt and the lake region than the old project, which would entail almost insuperable difficulties in the sudd regions of the middle Nile. The map accompanying the paper is based on a prismatic compass traverse. No astronomical observations were taken.

It is announced by the *Times* that Sir Arthur Steel-Maitland, Under-Secretary for the Colonies, will be the Parliamentary Secretary of the new department which is being created to improve our commercial intelligence system, and that his successor at the Colonial Office will be Mr. W. A. S. Hewins. The Commercial Intelligence Department will eventually comprise the existing Department of Commercial Intelligence of the Board of Trade and the Foreign Trade Department of the Foreign Office, and will take over such of the staff and records of the War Trade Intelligence and Statistical Departments as may be available and required. The official head of the department will be an officer appointed jointly by the President of the Board of Trade and the Secretary of State for Foreign Affairs, working under the new Parliamentary Secretary. The appointment and control of the Trade Commissioners within the Empire will, as at present, rest with the Board of Trade, and the appointment and control of the Commercial Attachés and Consular Service with the Foreign Office, but the work of the new department will comprise all matters dealing with commercial intelligence, and, so far as is necessary for that purpose, it will give directions to the oversea services and make the necessary arrangements for keeping them in close touch with the commercial classes in this country. The department will be assisted by an Advisory Committee of business men, and it is hoped that it will be possible to arrange for a sub-committee of this committee to meet at frequent intervals in order to advise the department on its current work.

A correspondent of the *Pioneer Mail* of August 11 shows that there are still some unexplored byways in the study of the animals of India. The lion is believed to be now confined to the Gir forest of Kathiawar, but news has been received of the discovery of the skin of an animal supposed to be a lion in Assam. In the Khasia Hills there were said to be animals like small pigs, but with feet like dogs. These have now turned out to be badgers. The one-horned sheep of Nepal was at one time regarded as fabulous, but ten years ago it was found to be a fact, and the writer states that he possessed two specimens, one of which was sent to the experimental farm at Shillong, where it probably may still be examined.

The alertness of the United States Bureau of Fisheries and the thoroughness of its operations are well illustrated in the issue of *California Fish and Game* for July, where Mr. J. N. Cobb directs attention to the wholesale waste of fishery products which could well be turned to profit. In the salmon fisheries of the Pacific coast, he remarks, 140,000,000 salmon were taken during 1913. The preparation of these fish for the market resulted in the loss, in the form of offal, of no fewer than 101,186 tons, all of which could have been "worked up into merchantable products." Millions of pounds of salmon eggs, now run to waste, could, he insists, be converted into caviare. In Siberia during this year no fewer than 259 tons of such eggs were thus prepared, as against 24,000 lb. on the Pacific coast of America. The rest of the offal, he suggests, should be converted into fertiliser and oil. Alaska harbours enormous numbers of trout, representing four species, all of which could be canned, as are the salmon further south. No less neglected, he shows, are various species of the Mollusca and Crustacea. He also advocates the use of whale meat and the skins of hair seals for leather. Finally, he points out, there are great possibilities for the use of the various kinds of seaweed. These we in this country could also profitably adopt.

The gipsy moth, *Porthetria dispar,* was accidentally introduced from Europe into Massachusetts in 1868, and is now widely spread throughout eastern New England, where the caterpillars annually defoliate and kill many broad-leaved trees. The State of Massachusetts has spent more than 1,000,000 dollars in unsuccessful efforts to exterminate this pest, which does so much damage to shade and fruit trees. It has lately invaded the forests, attacking especially oak, aspen, poplar, beech, lime, and birch. It is impossible, on account of the expense, to have recourse in the forests to the spraying methods which are useful in orchards and city avenues. Messrs. G. E. Clement and Willis Munro, in U.S. Dept. of Agriculture Bulletin, No. 484, give the results of their investigations as regards the liability of the various forest trees to attack, and propose certain measures of defence, which depend mainly on the elimination by felling of species sought after by the larvæ, and on the cutting of dead and dying trees generally. In this region the problem is complicated by the presence of two other exotic plagues, the chestnut-bark disease, supposed to have been introduced from Japan, and the white pine blister rust, which was imported with nursery stock from Germany. These two fungoid diseases are so serious as to endanger the continued existence in the United States of two valuable timber trees, the chestnut and the white pine.

The seat of the olfactory sense in spiders, hitherto a matter of speculation, seems to have been determined, at least in the trap-door spiders, by Mr. John Hewitt, who describes his investigations on living spiders in the *South African Journal of Science* for March, which has just reached us. From Mr. Hewitt's experiments with scent-tipped rods there appears to be no doubt that this sense is located in the feet, and more directly, perhaps, in the "scopula"—the pad of fine and specially modified hairs seated on the lower and lateral surfaces of the tarsi. Whether females lack this sense or not is a matter for conjecture. At any rate, they do not respond to the tests which so readily stimulate the males into action. The author suggests that it is by the sense of smell that the males find their mates. If this be so, then it would appear that the females remain odourless during their periods of sexual inactivity, for males used in these experiments showed no sign of response when placed near females. When placed on a tablecloth having a woolly surface males at once adopted the characteristic courting attitude, the appropriate movements being apparently stimulated by the likeness of the fibres of the cloth to the threads set free by the female in her immediate neighbourhood when desirous of mating, at which time the male also

releases threads from the spinnerets. Mr. Hewitt's observations, though briefly stated, are sure to attract the attention, not only of students of the Arachnida, but also of all who are interested in animal behaviour.

MR. G. F. BECKER (United States Geological Survey, Professional Paper 98—N) investigates the "Mechanics of the Panama Canal Slides," and concludes that "a limit is set to the vertical height of a cliff or [of?] any rock." This limit allows a face of 3700 ft. in granite, which is well above that of El Capitan in the Yosemite Valley. When breaks have opened parallel to the rock-face, a horizontal shear has started at the base of the cliff, and outward movement can be checked only by the removal of material and the sloping back of the surface of the unstable mass.

WE have received a copy of a publication of the Carnegie Institution of Washington entitled "A History of Transportation in the United States before 1860." The large volume, which is the work of many authors, has been put together and edited by Miss C. E. MacGill. The development of transportation is traced from the trails of the earliest settlers, through later roads, turnpikes, and canals, to modern railways. The study is mainly historical and economic, but the geographical point is not lost sight of, particularly in the chapters on the early trails and on the canals and waterways. Coloured maps show the navigable rivers of the United States, the canals, and the railways in operation in 1840, 1850, and 1860. There is a bibliography of several hundred entries and a full index.

THE United States Coast and Geodetic Survey celebrated the centenary of its commencement on April 5 and 6, 1916, and the addresses which were then delivered have been recently published by the Survey. These addresses summarise the past work of the Coast and Geodetic Survey in the fields of geodesy, verification of standards, terrestrial magnetism, hydrography, tidal investigations, etc. They give a convenient summary of the work which has been accomplished, and we notice that throughout its history the Survey has always given a prominent place to investigation and research, while the design and improvement of instruments for the execution of the highest class of geophysical operations have been kept in mind, and much has been done in this direction.

WHEN the new Swedish State Museum of Natural History was opened to the public the palæobotanical department was not complete, owing to the illness of Prof. Nathorst. The collection, which, besides fossil plants, contains also the recent Archegoniates, has now been arranged in its new quarters, which are appropriately adorned by busts of A. E. Nordenskiöld and Oswald Heer, as well as by coloured pictures of past floras. The small collections of fossil plants which belonged to Swedenborg, Per Hasselquist, Hisinger, and others are kept together for the sake of their historical interest. The remaining exhibited fossils are arranged in two series. One, in cases along the walls and by the windows, is systematic, and represents the morphological development. The divisions adopted are: Equisetales, Pseudoborniales (a group hitherto found only in the Upper Devonian rocks of Bear Island), Lycopodiales, Filicales, Pteridospermeæ, Cycadophyta, Ginkgogales, Cordaitales, and Coniferales. The other half of the collection is arranged stratigraphically, and occupies several cases in the middle of the hall. The main study-series are in other rooms. Thanks to the energy of Prof. Nathorst, all these series are not only remarkably rich, but also of high scientific value from both the geological and the botanical aspect, and it is needless to add that the department is fully provided with laboratories and all that is required for the care of so important a collection.

IN order to release part of the large quantity of grain used in distilleries and to augment the food supplies of the country a reduction of the amount of potable spirits produced has been enforced. One of the consequences of this restriction was the curtailment of the output of yeast available for bread-making. To meet this possible difficulty Mr. Julian L. Baker was asked by the Royal Commission on Wheat Supplies as to the possibility of using brewers' yeast for the purpose. The results of his investigations are published in the Journal of the Society of Chemical Industry for July 31. The conclusions drawn are: (1) That a mixture of distillers' yeast and brewers' yeast (from any part of the United Kingdom) will effect a satisfactory fermentation of dough, the brewers' yeast being contributory to the fermentation and not merely a diluent; (2) that, using a mixture containing 33 or 50 per cent. of brewers' yeast, the doughing period will be slightly prolonged (about 20 per cent.) if the yeast rate is low; (3) that brewers' yeast alone is useless in the ordinary "quick doughing" process, but with it good loaves can be made of a "slow dough"; (4) that a deficit in the supply of distillers' yeast to bakers could be met by means of brewers' yeast within certain limits; (5) that brewers' yeast alone will produce palatable loaves; and (6) that with the present output of beer 200 to 250 tons of brewers' yeast per week would be available for bakers at a much lower price than that paid for distillery yeast, of which 700 tons are used weekly. In order to avoid the risk of imparting a yeasty and bitter flavour to the bread, the brewers' yeast should be washed with a dilute solution of salt and then submitted to a short, brisk fermentation in a dilute mash-tun wort. Mr. Baker is of the opinion that bakers could use a mixture of equal parts of brewers' and distillers' yeast without any serious inconvenience to their trade or disadvantage to the public.

THAT caustic soda solutions at temperatures in the neighbourhood of 100° C. produce brittleness in soft steel has long been known and has been the subject of several investigations. No satisfactory explanation has yet been reached, and the matter has been recently taken up by Prof. S. W. Parr and further investigated. The account of his work is published in Bulletin No. 94 of the Engineering Experiment Station of the University of Illinois. That the embrittling effect of caustic soda is due to the evolution of hydrogen and its absorption by the steel in the nascent state is generally conceded. The author shows that during the action of the alkali at 100° C. the electrical potential of the steel is considerably raised, and that it extends from the surface into the specimen for a distance of, at any rate, 0·30 in. This increase is also brought about by immersion in dilute acids and by cathodic polarisation. The potential is in all cases higher after treatment of any sort that evolves nascent hydrogen, and this fact points to the occurrence of a molecular change in the steel. This high potential disappears in many cases after a lapse of time, and after heating to from 100° to 200° C. in air, but no relation was established between its presence and the existence of brittleness. Indeed, the author states that the potential increased long before brittleness was manifested. By using sodium dichromate as a depolariser in the caustic soda solutions the author found that the rate of corrosion at 280° C. was much diminished, and that the toughness of the steel, as judged by the repeated bending test, suffered no deterioration. A complete explanation of the cause of brittleness is still to seek.

IN Bulletin No. 95 of the Engineering Experiment Station of the University of Illinois Messrs. Yensen and Gatward describe the results of a research on the properties of iron-aluminium alloys. The alloys were

made in magnesia crucibles heated in an Arsem vacuum furnace by melting pure iron and afterwards dropping in aluminium, the latter being suspended in the form of wire or rod from a very fine wire extended between insulating posts which passed through the cover of the furnace. At the required moment this was fused. In this way alloys containing up to 13 per cent. of aluminium were obtained, and are stated by the authors to be less contaminated with impurities than any previously made. The alloys classed as uncontaminated contain from 0·01 to 0·02 per cent. of carbon. Other alloys containing more carbon are classed as contaminated and are used to show the effects of carbon. Aluminium is a more powerful deoxidiser than silicon and does not commence to combine with iron until all the oxides present have been reduced. It forms solid solutions with iron throughout the range studied. The alloys have been studied chiefly from the point of view of their magnetic properties. Aluminium, like silicon, has a beneficial effect when added in small quantities. The best alloy obtained, containing 0·4 per cent. of aluminium, has a maximum permeability above 35,000 when annealed at 1100° C. The hysteresis loss for B. max. = 10,000 and 15,000 is 450 and 1000 ergs per c.c. per cycle respectively. The specific electrical resistance increases, about 12 microms for each per cent. of aluminium added up to 3 per cent. Above this the rate of increase falls off gradually.

OWING to the shortage of superphosphate prepared in the ordinary way with sulphuric acid various suggestions have been made to supply the deficiency (such as the action of nitre-cake on rock phosphate), or to use what ordinary superphosphate there is available to the greatest advantage. For the latter purpose admixture with insoluble phosphate has been advocated. Concerning this proposal, the results obtained by Mr. G. Scott Robertson (Journal of the Society of Chemical Industry, June 30) are of considerable importance. Mr. Robertson finds that when ordinary superphosphate is mixed with basic slag the greater part of the water-soluble calcium phosphate contained in the former reverts to the insoluble form almost at once by the action of the free lime in the basic slag, whilst on keeping the mixture a slower change in the same direction is observed Thus when a superphosphate containing 26 per cent. of water-soluble calcium phosphate was mixed with an equal quantity of basic slag (containing 1·7 per cent. of free caustic lime), the mixture, instead of containing 13 per cent. of water-soluble phosphate, contained only 5 per cent. immediately after mixing, and only 2·8 per cent. after keeping for fourteen days, after which period the composition altered but slightly. When the basic slag is replaced by an equal proportion of natural rock phosphate there is a much smaller reversion, so that there is no serious objection to such a mixture being used by farmers. A mixture of Gafsa rock phosphate with an equal weight of superphosphate contained 12·7 per cent. of water-soluble phosphate (instead of 13 per cent.) immediately after mixing, and 10·4 per cent. at the end of fourteen days. Gafsa phosphate (which rarely contains more than 0·75 per cent. of calcium oxide in the form of free carbonate) is probably the most suitable for mixing with superphosphate. Then come Egyptian phosphate, Florida pebble phosphate, Makatea Island phosphate, and Tunisian and Algerian phosphates, in order of suitability.

THE Scottish Motor Traction Company, which runs a number of motor omnibuses in Edinburgh and the district, has taken up the use of coal-gas as a substitute for petrol, and a photograph of one of its vehicles appears in the *Engineer* for September 14. The gas-holder consists of a large flexible container, which covers the entire roof of the vehicle, the arrangement being similar to that adopted in other vehicles of this type. The simplicity and low cost of the flexible receiver charged with gas at low pressure warrant careful consideration of the system as a war measure. Although the quantity of gas which can thus be carried is limited, this disadvantage is to some extent compensated for by the ease with which the gas-holder can be recharged. Further, high-pressure receivers are not easy to procure at the present time. Owing to the low pressure—about 0·2 in. of water—a meter delivering into the receiver races unless some form of throttle is interposed. A short length of small-bore piping, or a diaphragm with a suitable aperture, is recommended so as to retain the pressure drop in the meter within reasonable limits.

WRITING in the *Tohôku Mathematical Journal*, vol. xi., 3, Mr. Hastime Tanate discusses the logical foundations for negative and imaginary quantities and expresses the view that the existence of these quantities may be explained independently of any geometrical considerations.

OUR ASTRONOMICAL COLUMN.

DISTRIBUTION OF SPIRAL NEBULÆ.—The distribution of spiral nebulæ has been further investigated by Dr. R. F. Sanford, with the aid of photographs obtained with the Crossley reflector (Lick Observatory Bulletin, 297). The photographs were taken with exposures of the order of twelve hours, the object being to find out whether new nebulæ could be detected in regions of the Milky Way which have hitherto seemed barren of them. They afford no evidence of undiscovered faint nebulæ in the regions where they have not previously been found with shorter exposures. It is shown that there is greater average brightness for the extra-galactic than for the galactic spirals, and that the nebulæ which lie nearest to the Milky Way are on the average of larger angular size than those away from it. F. G. Brown has shown that the larger nebulæ in general are the brighter, but this is not true of spiral nebulæ near the Milky Way, which are large and faint. Thus, if angular size be taken as a criterion of distance, it follows that something cuts off the light from the galactic spirals, thereby letting only the nearer ones be perceptible, and then only with diminished brightness. An arbitrary and general distribution of the spiral nebulæ can be best harmonised with the observed features of the distribution by assuming the existence of an obstructing medium, which is irregularly scattered throughout the galaxy. It is considered probable that the spirals are not only outside our own system, but that they can have no intimate connection with it dynamically.

THE GREAT SOLAR PROMINENCE OF 1916, MAY 26.—A detailed account of the great eruptive prominence of 1916, May 26, which reached a maximum height of half a million miles, and in some parts attained a velocity of 457 km. per second, has been given by Mr. Evershed (Kodaikanal Bulletin, No. 55). One of the most striking results of the measurements of the photographs is to show that all parts of the prominence were moving radially outwards from a point in the chromosphere at the base of the main column. It is considered probable that an eruptive prominence begins as an unusually dense low-lying mass of gas which may persist without much change for several days, and then suddenly become unstable, becoming subjected to a force which tears it to shreds and sends the frag-

ments flying into space with accelerating speed. The dissipating force, as indicated by the great prominence, lies at the surface of the sun, and may be localised in a very restricted area. The main stem consisted of a stream of rapidly moving gas, which was brilliantly luminous when it formed a continuous column, but so soon as the continuity was broken by the stoppage of the supply of gas from the chromosphere, the separate detached masses faded very rapidly. The rapid fading is probably to be explained by the extremely low density of the gas involved. Mr. Evershed argues that the density is so small that the gas can have no temperature in the ordinary sense; its emissive power will thus be dependent only on absorption of photospheric radiation, which is apparently insufficient to maintain luminosity at great heights. A remarkable feature of the great eruption was the practically simultaneous fading of the entire prominence.

COLOURS OF STARS IN GALACTIC CLOUDS.—In continuation of his work on the colours and magnitudes of stars in clusters, Dr. Harlow Shapley has determined the colours and magnitudes of 300 stars in the galactic clouds surrounding the cluster Messier 13 (*Astrophysical Journal*, vol. xlvi., p. 64). A wide range of colour is apparent among these stars, and the distribution of spectral types among the 14th magnitude stars appears to be much the same in this distant galactic region as in the immediate vicinity of the sun. Stars of all colours are included in each interval of magnitude, and so far as colour is an index of intrinsic luminosity, this may be accepted as an indication of considerable difference in the distances of such stars. The wide dispersion in magnitude of both blue and red stars suggests that the extent of the stellar clouds in the line of sight is relatively very great, possibly greater than the distance to the nearer boundary. The cluster Messier 11 proves to be a physical group in the midst of the star-clouds, which on their own part have the general appearance, and some of the properties, of an enormous, but definitely outlined, physical system. There is as yet no certain evidence of the existence of dwarf stars either in the cluster or in the galactic clouds. The cluster stars are probably giants in luminosity, and the distance of the group is of the order of 15,000 light-years.

GERM-CELLS AND BODY IN INHERITANCE.

IN NATURE for March 15 of this year (pp. 55–56) some account was given of a summary of Dr. Raymond Pearl's researches on the progeny of alcoholised fowls. A later and much fuller description of this important work has now appeared in the *Journal of Experimental Zoology* (vol. xxii., 1917, pp. 125–86, 241–310), under the title of "The Experimental Modification of Germ-cells." This paper is divided into three sections, the first of which describes the general plan of the experiments, and the second the effect upon the domestic fowl of the daily inhalation of ethyl alcohol and other substances, while the third discusses the effect of parental alcoholism and certain other drug intoxications on the progeny. The general results of the experiments have already appeared in NATURE (*loc. cit.*). Dr. Pearl alcoholised his fowls by inhalation because the birds refused to drink alcohol, even if highly diluted; Prof. Stockard had previously found it impossible to administer alcohol to guinea-pigs satisfactorily by the stomach, and had therefore also adopted the inhalation method. While the progeny of Stockard's guinea-pigs had been as a rule weakly and deformed, the offspring of Pearl's treated fowls were stronger, though less numerous, than those of his "controls." In the case of the birds the effect of the alcohol on the germ-cells seems therefore to have been selective, whereas with the rodents it was utterly deleterious. A possible cause of the difference, which does not seem to have occurred to Dr. Pearl, may be the great contrast between the respiratory mechanism in birds and in mammals; the residual air in the lungs of the latter might be expected to increase the effect of the inhaled poison. Further, the excessive degradation of the offspring of Stockard's guinea-pigs suggests that the germ-cells of those animals are peculiarly sensitive to adverse influences.

The temptation to argue from these divergent results to the terribly practical problem of alcoholism in the human race is great, and Dr. Pearl does not altogether resist it. Clearly, however, the effect of the inhalation of ethyl alcohol by a Plymouth Rock hen, or even by a guinea-pig, cannot be closely compared with the effect of alcohol swallowed by the whisky- or beer-drinker. The latter effect can be studied elsewhere than in biological laboratories.

Another aspect of the affection of germ-cells is illustrated for plants by Mr. S. Ikeno's "Studies on the Hybrids of *Capsicum annuum*," part ii., "On Some Variegated Races," in a recent number of the *Journal of Genetics* (vol. vi., No. 3). A variegated race of this species appeared in 1913 by mutation, producing, exclusively by self-fertilisation, plants which have always variegated foliage, but which differ widely in the intensity of the variegation. Self-fertilised flowers on green branches of a variegated plant yield variegateds, in the majority of which the variegation is slight. By hybridising variegated with green the degree of variegation in the offspring is diminished. Variegation is transmissible in either the male or the female line, but the transmission "is not through the nucleus, but through the cytoplasm; especially the plastids contained therein may be regarded as organs of transmission," and the author believes that some cytoplasm containing plastids may be introduced by the male gamete into the zygote. Analogous cases of plant-inheritance have been previously discussed by Correns, Gregory and others. Variegation depends upon the presence of plastids which have no power of forming chlorophyll, which may, indeed, be regarded as diseased, so that though the character is due to a kind of infection suffered by the germ-cells, it is not strictly blastogenic.

The same part of the *Journal of Genetics* contains a paper by Dr. R. Ruggles Gates on "Vegetative Segregation in a Hybrid Race of Œnothera (*Œ. rubricalyx × biennis*," in which somewhat similar questions are raised. The bud-colour character shows Mendelian segregation, which may reasonably be considered dependent on normal chromosome distribution in meiosis. But in the size of petal there is a range of variation that suggests "somatic variation and segregation . . . determined by diversities appearing in nuclear or cytoplasmic material during somatic mitoses." Here, therefore, we have another example of the necessity for clearing issues in the study of inheritance.

The broader aspects of evolution are discussed by Dr. Raymond Pearl in an article entitled "The Selection Problem" (*American Naturalist*, vol. li., 1917, pp. 65–91). Insisting on the necessity of experimental proof and the determinative action of germinal characters, he concludes that "natural selection is no longer generally regarded as the primary, or perhaps even a major, factor in evolution." Yet, in stating that "natural selection is, from the point of view of modern genetics, a somatic theory," he surely goes far beyond the available evidence, and seems to ignore the principle that characters of selection-value must be re-

garded, by all who believe the Darwinian factor to be operative in organic evolution, as transmissible. In a later number of the *American Naturalist* (vol. li., pp. 250–56) Dr. W. H. Longley has criticised Dr. Pearl's argument, expressing the opinion that "neither genetic research nor studies upon elimination closely limit the possibility that selection has played a very important part in evolution. . . . Recent field studies demonstrate novel facts of common occurrence which must apparently be ascribed to the action of this factor." G. H. C.

TERRESTRIAL MAGNETISM.

ON the occasion of the centennial celebration of the United States Coast and Geodetic Survey, held in April, 1916, Dr. L. A. Bauer delivered an address on the work done by the Survey in terrestrial magnetism, which has now been separately published. Dr. Bauer was himself in charge of the magnetic work of the Survey from 1899 to 1906, and was largely responsible for its greatly increased activity during the present century. Up to the end of 1915 the Survey had made magnetic observations at 5500 land stations, and its ships had taken many observations at sea, while five magnetic observatories were in constant operation. Magnetic charts of much increased accuracy had been published for the United States, and a reduced copy of the chart for 1915 is included in the publication. Dr. Bauer advocates the erection of a new magnetic observatory in the Panama zone, and the uninterrupted maintenance of the existing observatories for a number of years. He expresses some interesting opinions as to the relative importance of theory and observation, which, coming from a man of his great experience, deserve careful consideration. "All experience," he says, "tends to show that, instead of looking upon the establishment of a theory as the goal of an investigation, it should ever be regarded merely as a means to the goal, the advancement of human knowledge." He speaks with feeling of the "uselessness of empirical formulæ for the purposes of prediction" (of secular change), and his final advice to the superintendent of the Coast and Geodetic Survey is "*continued, unceasing, and intelligent observation.*"

The annual report of the director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for the year 1916 extends to fifty pages. It mentions that vol. iii. of the researches of the department is nearly ready, and that it will contain the final results of the ocean magnetic work from 1905 to 1914, and preliminary results of a recent cruise of the survey ship *Carnegie*, extending from March, 1915, to September, 1916. The present publication gives a good many details of this cruise. The *Carnegie* sailed in the first instance from Alaska to New Zealand, then circumnavigated the south polar regions, the track lying mainly between 50° S. and 60° S., and finally returned from New Zealand to San Francisco. Tables give full particulars of the errors observed in the British, German, and American charts on the several journeys. In most areas the errors are less than 1°, but in several they are considerably larger. The largest errors were observed near 59° S., 110° E. They were as large as 10°, or even 12°, in the British and American charts, and still larger in the German. The land work done in the year includes observations in South Africa, South America, China, and Australasia. The department has taken steps for the erection of a magnetic observatory about 100 miles north of Perth, Western Australia. At the end of the report is a series of abstracts of recent scientific publications by the staff of the department, including several dealing with atmospheric electricity.

AMERICAN FOSSIL VERTEBRATE ANIMALS.

A PAUSE in the discovery of strange new forms of extinct vertebrate animals in North America has afforded an opportunity for obtaining more exact knowledge of some species hitherto known only by fragments. It has also given time for a more careful consideration of the habits and affinities of several problematical types which have previously been only hastily discussed. The American Museum of Natural History, New York, has been especially active in furthering such research, and has lately published in its Bulletin four papers of more than usual interest.

It has long been known that at the beginning of the Tertiary period there were very large and stout running birds both in Europe and in America. The greater part of a skeleton of a new species of Diatryma, which was found last year in the Lower Eocene of Wyoming, shows for the first time the true nature of one of these birds. The remains, as usual, are not sufficiently well preserved to exhibit all the features that are needed for an exact systematic determination; but, according to the studies of Messrs. Matthew and Granger, Diatryma is now proved to be more closely related to the South American crane-like bird, Cariama, than to any other known form. It can no longer be associated with the ratite birds, with which the first fragments were compared. The new species, *Diatryma steini*, must have been about 7 ft. high when standing, with a short and massive neck and an enormous head having a high compressed beak. It would, indeed, present much the appearance of the well-known Phororhachos from the later Tertiary formations of the Argentine Republic, which is also generally compared with Cariama. The discovery of such a bird in the oldest deposits of the Tertiary period shows how early must have been the differentiation of the birds into the groups which are familiar at the present day.

Of the Dinosaurian reptiles with hind limbs nearly like those of running birds, much has been learned by the discovery of nearly complete skeletons in the Upper Cretaceous of Alberta, Canada. Prof. H. F. Osborn therefore takes advantage of the opportunity of discussing these in connection with the skeletons of Ornitholestes from the Upper Jurassic of Wyoming, and of Tyrannosaurus from the Upper Cretaceous of Montana. He also publishes many beautiful drawings of osteological details. The forms previously known were obviously grasping flesh-eaters; but the new Struthiomimus has a small toothless skull shaped much like that of an ostrich. Prof. Osborn, indeed, thinks it most probable that this strange reptile had the same mode of life and habits as an ostrich.

Equally great diversity is being met with among the armoured and horned dinosaurs from the Upper Cretaceous of Alberta, but all the remains hitherto described are more or less fragmentary. A nearly complete skeleton of Monoclonius, now made known by Mr. Barnum Brown, is therefore of great interest and value. Compared with the hypothetical restorations of Triceratops, the body is shorter and deeper in the posterior dorsal region, while the feet are more digitigrade with toes turning outwards, the axis of the manus being through the second digit, that of the pes being between the second and third digits. There is no bony exoskeleton, but the epidermis is hardened into low, polygonal tubercles, which do not overlap.

The gigantic herbivorous dinosaurs such as Diplodocus present as many difficulties in nomenclature as whales, and Prof. Osborn, with the help of Mr. Charles C. Mook, is now attempting to decide which characters can best be used for the recognition of

the several species. Taking Apatosaurus as an illustration, Mr. Mook points out the necessity of making allowance for differences of age in the various individuals compared; which differences can generally be recognised by studying the degree of fusion of certain bones and the development of crests and rugosities on them.

As an aid to the study of Prof. Osborn's numerous papers on the fossil vertebrate animals, we welcome the handsome second edition of the Bibliography of his published writings which we have just received. It includes a classified index as well as the usual chronological list, and forms a most useful compendium for the student. It shows not merely where Prof. Osborn has described the various fossils, but also where he has discussed the points of philosophical interest which arise from these descriptions.

A. S. W.

FORTHCOMING BOOKS OF SCIENCE.

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ANTHROPOLOGY AND ARCHÆOLOGY.

Constable and Co., Ltd.—Tools and Weapons, illustrated by the Egyptian Collection in University College, London, and 2000 outlines from other sources, Prof. W. M. Flinders Petrie; Scarabs and Cylinders, with names, illustrated by the Egyptian Collection in University College, London, Prof. W. M. Flinders Petrie. *Macmillan and Co., Ltd.*—Folk-Lore in the Old Testament, Sir J. G. Frazer, two vols. *Methuen and Co., Ltd.*—Primitive Ritual and Belief, E. O. James.

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EXPLORATIONS IN THE HAWAIIAN ISLANDS.

PROF. A. S. HITCHCOCK, of the U.S. National Museum, and his son, travelled recently in the Hawaiian Islands, studying the flora, especially with reference to the grasses, making what might be termed a forage survey.

The islands visited were Kauai, Oahu, Lanai, Molokai, Maui, and Hawii. They are all of volcanic origin and composed of lava, except a very small part, which is of coral formation. Kauai, geologically the oldest island, shows the greatest effect of erosion, its deep canyons rivalling the beauty of the Grand Canyon of Colorado. The rainfall on the mountains of the windward side is excessive, that of Waialeale, the highest peak of Kauai, being as much as 600 in. per annum. But the lee side of the islands is arid, the rainfall being often reduced to fewer than 15 in. per annum.

To the south the islands are successively younger, Hawaii, the largest, being even now in a state of volcanic activity. On this island are situated the two highest peaks of the group, Mauna Kea, 13,825 ft., and Mauna Loa, 13,675 ft. in height. There is scarcely any vegetation upon these peaks, above 10,000 ft., especially upon Mauna Loa, which is made up of comparatively recent lava. Much snow covers the peaks in winter, extensive banks persisting throughout the year. The magnitude of the mountain mass is greater than at first appears, because the cones arise from the very floor of the ocean, 18,000 ft. below the surface, thus making the total height more than 30,000 ft. So gradual is the slope from the sea to the summit that the eye is deceived and the great height is not at first fully appreciated. The active volcano, Kilauea (4000 ft.), with its pit of boiling lava, is on Hawaii, while Haleakala, said to be the largest crater in the world, is on Maui, the second largest island of the group.

Important agricultural industries of the island include sugar, live stock, and pineapples. The native Hawaiian population is decreasing, and it is only in the less accessible parts of the islands that the primitive customs still prevail. Here may be found the native grass huts made of a wooden framework filled in with a thatch of grass. The grass used for this purpose is usually pili (*Heteropogon contortus*), an indigenous grass, abundant upon the rocky soil of the lowlands.

The introduced flora is very noticeable near towns, ranches, and plantations, and one must go several miles from Honolulu to find indigenous or native plants. Of sixty species of grasses found on Oahu, about fifty were introduced from foreign countries. One of the introduced trees of great economic importance is the algaroba tree (*Prosopis juliflora*) or kiawe, as the Hawaiians call it. It is found in a belt on the lowlands along the shores of all the islands, and occupies the soil almost to the exclusion of other plants. The pods are very nutritious, and are eagerly eaten by all kinds of stock. Its flowers furnish an excellent quality of honey. The Molokai ranch alone produces 150 to 200 tons of strained honey per year. The prickly pear cactus (*Opuntia tuna*) has become extensively naturalised in the drier portions of all the islands. Two introduced shrubs, Guava and Lantana, now occupy extensive areas, and have become great pests. In the moister portions of the islands large areas have been occupied by Hilo grass, which has little value as a forage plant. The kukui, or candlenut, tree (*Aleurites moluccana*), with its light, almost silvery, green foliage is now a common and rather striking element in the valleys and gorges.

The indigenous flora is highly interesting, though not abundant in species. Two of the commonest trees are the ohia (*Matrosideros polymorpha*) and the koa (*Acacia koa*). The former, also called ohia lehua and lehua, resembles, in the appearance of the trunk, our white oak, but bears beautiful clusters of scarlet flowers with long, protruding stamens. The koa produces a valuable wood much used in cabinet-making. Characteristic of the upper forest belt on the high mountains of Hawaii is the mamani (*Sophora chrysophylla*), a leguminous tree with long, drooping clusters of yellow flowers and long, four-winged pods constricted between the seeds. In the arid regions is found the wiliwili (*Erythrina monosperma*), a deciduous tree with gnarly growth. Its bare branches are conspicuous, as deciduous trees are unusual in the tropics. It has very soft light wood, and bright scarlet seeds. Among the peculiar plants of the islands is the silversword (*Argyroxiphium sandwicense*), a strikingly beautiful composite with glistening silvery leaves, which grows only on the slopes of cinder cones in the crater of Haleakala, and in a few very limited localities on Hawaii. The family Lobeliaceæ is represented by about 100 species belonging to six genera. The numerous arborescent or tree-like species are very peculiar and characteristic. Many of them form slender trunks like small palms, crowned with a large cluster of long narrow leaves, the trunks of some species being as much as 30 or 40 ft. high.

The indigenous grasses of the Hawaiian Islands are not numerous. A tall species of Eragrostis is the dominant grass upon the plain between Mauna Loa and Mauna Kea. Upon many of the summits of the high mountain ridges in the regions of heavy rainfall are found open bogs which support a peculiar and interesting flora. Many species form more or less hemispherical tussocks which rise above the general level of the bog. A showy lobelia with numerous large cream-coloured flowers as much as 3½ in. long, peculiar violets, and a sundew are found there. These boggy areas are devoid of trees, and sometimes occupy

rather extensive areas, the one on Mt. Waialeale covering several square miles.

Three species of tree ferns are found on the islands, and in some places form extensive forests. These plants produce at the base of the stipe a great ball of brownish-yellow wool called pulu by the natives, and used by them for stuffing pillows and mattresses.

HIGHER EDUCATION IN THE UNITED STATES.

THE report of the U.S. Commissioner of Education for the year ended June 30, 1916, has been received from Washington. It consists of two bulky volumes, one running to 692 pages and the other to 663 pages. The first part contains a comprehensive survey of the progress of education in the United States for the school year 1915–16, and also a similar account of educational progress in all those foreign countries from which the U.S. Bureau of Education could obtain sufficient information. The second volume is given up to educational statistics, but owing to the difficulty of compiling such a mass of data and the time absorbed in the task, the numbers provided deal only with the year 1914–15.

The Cost of American Education.

The estimated cost of education in the United States in 1914 was very nearly 160,000,000*l*. An estimate, making due allowances for the time which has elapsed since the date given, would easily bring the current educational expenditure in the States to 200,000,000*l*. Public elementary schools cost approximately 100,000,000*l*.; public high schools, 14,000,000*l*.; private elementary schools, 10,400,000*l*.; private secondary schools, 3,000,000*l*.; universities, colleges, and professional schools, 20,000,000*l*.; and normal schools, 3,000,000*l*.

Gifts and Bequests.

The Bureau of Education periodically publishes tabular statements showing the amounts of gifts and bequests to education. The total for 1914 reached 6,271,490*l*., the greatest ever recorded for a single year. For the academic year 1914–15 the total amount received in this way was 4,062,050*l*.; and of this about 1,997,000*l*. was for increase of plant, 711,300*l*. for current expenses, and 2,153,800*l*. for endowment. Thirty-five universities, colleges, and technological schools reported gifts of more than 20,000*l*., the total amount received by these institutions reaching 2,987,160*l*. The following institutions each received more than 100,000*l*.:—Johns Hopkins University, 271,820*l*.; Wellesley College, 255,585*l*.; Harvard University, 244,000*l*.; University of Pennsylvania, 234,700*l*.; University of Chicago, 228,876*l*.; Yale University, 193,160*l*.; Princeton University, 157,909*l*.; and Massachusetts Institute of Technology, 155,453*l*.

The generous benefactions received for education in the States during 1914 were distributed among the various classes of educational institutions as follows:—

	£
Universities and colleges	5,334,010
Schools of theology	311,660
Schools of law	40,610
Schools of medicine	299,150
Public normal schools	121,490
Private normal schools	23,260
Private high schools	141,310
	£6,271,490

For the forty-four years from 1871 to 1914 inclusive the grand total of gifts and bequests to American education reaches 116,883,616*l*.

Number of Students.

For the year ending June, 1915, the U.S. Bureau of Education received reports from 563 universities, colleges, and technological schools in the different States. States and municipalities control ninety-five of these institutions, and private corporations control 468. There were 237,168 students in the collegiate and resident graduate departments of these institutions, and of this total 84,861 were women.

In the year 1915, 29,608 baccalaureate, 4140 graduate, and 883 honorary degrees were conferred. The degree of doctor of philosophy was conferred on examination by forty-three institutions on 486 men and 60 women.

Agricultural and Mechanical Colleges.

The institutions commonly known as "agricultural and mechanical colleges," or "land-grant colleges," are dealt with in a separate chapter of the report. In some States, it should be remembered, the agricultural and mechanical colleges form parts of the State universities, and in such cases the statistics respecting such universities concern themselves also with the activities of these departments

During 1914–15 particulars respecting sixty-nine agricultural and mechanical colleges were collected by the bureau. In the fifty-two institutions for white students there were 9742 instructors of various grades, and in the seventeen institutions exclusively for coloured students there were 529 instructors. The total number of students in these institutions was 125,075.

The total income of these colleges for 1915 was 6,392,353*l*., of which 3,601,221*l*. was State and the remainder Federal aid. In addition, the colleges received the following grants for the year:—U.S. grant for experiment stations, 273,858*l*.; State grants for experiment stations, 225,942*l*.; State grants for extension work and farmers' institutes, 215,001*l*.; and U.S. grant for extension work, 98,248*l*. The distribution, according to source, excluding the experiment station funds and the extension and farmers' institute funds, was Federal government 11 per cent., State 56 per cent., and private funds 33 per cent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE inaugural address for the session 1917–18 of the London (Royal Free Hospital) School of Medicine for Women will be delivered by Dr. L. Garrett Anderson, C.B.E., on Monday, October 1, at 3.30 p.m. The subject will be "Ambition."

MENTION was made in NATURE of May 17 (p. 238) of a bequest by the late Mrs. E. D. Denning, of South Norwood, of property for the application of modern scientific knowledge to educational needs. It is now announced in the *Times* (September 18) that Mrs. Denning left estate of the gross value of 169,719*l*., the net personalty being 78,581*l*. By her will she bequeathed "to the Public Trustee all her freehold property in trust for a 'Frank Denning Memorial' for the advancement and propagation of education in mechanical science in any part of the United Kingdom, with preference to those persons who reside in the Borough of Croydon."

A SECONDARY-SCHOOL Examinations Council has been constituted by the President of the Board of Education to assist the Board in the co-ordination of the examinations to which secondary schools now submit their pupils. The council is to consist in the first instance of the following representative members, with the Rev. William Temple, formerly headmaster of Repton School, as chairman:—Oxford and Cambridge Schools Examination Board, Mr. P. E. Matheson; Oxford Delegacy for Local Examinations, Mr. H. T. Gerrans;

Cambridge Syndicate for Local Examinations, Mr. J. H. Flather; University of Bristol, Sir Isambard Owen; University of Durham, Dr. W. H. Hadow; University of London, Dr. R. M. Walmsley; Northern Universities Joint Matriculation Board, Sir Alfred Dale, Prof. B. M. Connal, and Miss S. A. Burstall; County Councils Association, Mr. H. Mellish, C.B., and Dr. H. Lloyd Snape; Association of Municipal Corporations, Mr. Councillor Dawson and Mr. J. G. Legge; Association of Education Committees (not yet appointed); Teachers' Registration Council, Mr. P. Abbott, Miss F. M. Gadesden, Miss E. S. Lees, Mr. G. Sharples, and Mr. A. A. Somerville. For the present Mr. Christopher Cookson and Miss M. Kennedy, H.M. Inspector, will act as secretary and assistant secretary. All communications on the subject of secondary-school examinations should be addressed to the Secretary, Board of Education, Victoria and Albert Museum, Exhibition Road, South Kensington, London, S.W.7, and the envelope should be marked "Examinations Council."

WE have received a syllabus of the evening technological courses offered by the Leeds University, together with a list of scholarships and fellowships held in the University. The technological courses include civil and mechanical engineering, electrical engineering, coal-mining, textile industry, colour chemistry and dyeing, leather industry, and geology applied to sanitary and civil engineering. The courses are co-ordinated with those of the City Council's evening classes, and students under twenty-two years are required to have taken a preliminary course in a technical school and to have reached a certain standard of proficiency before entering the University. The object is to ensure that they shall derive full advantage from the more advanced teaching. In all the courses practical instruction forms an essential feature, and is carried out in buildings specially designed and equipped for the purpose. Of the scholarships, the value of which varies from 20*l.* to 40*l.* a year, tenable for two or three years, twelve in arts, science, or technology are awarded on the result of the examination of the Joint Matriculation Board, and about the same number by special examination or selection, in addition to which the local authority provides a number of scholarships in different branches of study. Among those specially allotted to technology are the Corbett Woodall scholarship in gas engineering (50*l*); the William Cooke and Co. in mining (21*l.*); the William Walker exhibition in fuel and leather (70*l.*–90*l.*); the Craven scholarship in engineering (25*l.*); and a number of Clothworkers' scholarships in the textile industry.

THE President of the Board of Education is delivering a series of addresses in various provincial towns with the object of explaining the Government's intentions in introducing the new Education Bill in the House of Commons. On September 14, at York, Mr. Fisher insisted that we cannot get good education without good teachers, and we cannot get these teachers unless we are prepared to pay for them; and to this end a large additional sum of money has been recently voted by Parliament for elementary education. In proceeding, he explained that it is proposed to extend the facilities for obtaining education. A full-time education up to the age of fourteen is to be insisted upon, and part-time day continuation classes for all young people except those who have obtained full-time secondary education up to the age of sixteen, or are otherwise under instruction. The Bill, the President went on to say, provides for very great elasticity and adaptation to local requirements. The education authorities will be expected to prepare schemes, and will be given a liberal allowance of time for their preparation, but will be required to consult the industrial interests of their localities. On September 15, at Sheffield, Mr. Fisher again referred to the education of boys and girls from fourteen to eighteen years of age. It would, he said, be a disgrace if the country came to the conclusion that some form of education for its adolescents was a good thing, but it was not prepared to disburse what is spent in thirty hours of war. The war has taught us that the nation is rich enough and powerful enough to pay for anything that it really wants. The Education Bill also, he pointed out, contains a large number of clauses devoted to the subject of physical and social education; for the first time it provides for a national system of physical training for young people. He expressed the belief that if the Bill passed into law it would prove to be one of the most powerful instruments ever invented for the furtherance of national health and physique.

THE Headmasters' Conference this year held its annual meeting in the summer holidays on September 12 and 13 at the City of London School. Dr. David, of Rugby, presided, and the first subject discussed was the report of the Royal Commission on the Public Services in India, as a result of which the following resolution was adopted unanimously:—"That this conference regrets, on educational grounds, the recommendation of the Royal Commission on Public Services in India that the age limits for the examination be lowered from twenty-two to twenty-four to seventeen to nineteen. If, however, the Government decides to lower the age, the conference strongly urges that in the educational interest of the candidates, and of other boys taught with them, no candidate be admitted to the examination under the age of eighteen, nor without a 'school certificate' or some similar qualification." Another resolution dealt with the new Secondary-School Examinations Council, on which no headmaster of a secondary school has yet been appointed. The resolution stated "That this conference is of opinion that the representation of teachers in schools should be not less than that of universities on the proposed Secondary-School Examinations Council." The age at which pupils may be transferred from one secondary school to another was discussed. It was generally agreed that a group of schools may with advantage specialise on particular groups of subjects for higher study, so that a boy destined for an advanced and specialised course may, at a later age, be taught in classes not too small. But it was thought to be essential that the change of school should be made at or before the age of fourteen. It was agreed "That the regulations of the Board of Education (Explanatory Note, Section III.) need modification or supplement, in so far as they seem to suggest transference of pupils at or about sixteen from one secondary school to another, experience having already shown that such transferences, unless made at a considerably earlier age, involve great educational loss to the pupil." Papers were read on the teaching of science in secondary schools, and the increase of epidemic disease in boarding-schools was among other subjects down for discussion.

SOCIETIES AND ACADEMIES.

NEW SOUTH WALES.

Royal Society, July 4.—Dr. A. L. du **Toit**: The problem of the great Australian artesian basin. The artesian waters are regarded as composite—residual, plutonic, and rainfall of an earlier epoch. The bulk of the residual water (Mesozoic) is considered to have been replaced by alkaline waters fed in at the sub-basaltic outcrops as well as from below, being evolved by, or derived from,

plutonic masses from which the younger Tertiary basalts—alkaline, trachytes, etc.—were derived. They permeated the Jurassic beds, and the reservoir became charged with waters of fairly uniform composition, carbonate of soda predominating over chloride—in the west. In the east the denudation of the basalt from the intake beds, accompanied by rainfall conditions in early Pleistocene, led to the accession of surface water which is not only displacing earlier accumulations, but also carrying salts downwards from the actual outcrop. The meteoric supply is considered to be the predominant, and the plutonic supply the subordinate, at the present day. Various lines of further inquiry are pointed out, and it is strongly urged that the Government may realise the extremely important and complex nature of the problem, and should sanction some scheme for its thorough study.—T. W. **Keele**: The Sydney water supply. The author relies upon the present catchment area of 350 square miles, on which there are seven available sites for storage reservoirs, together with the Woronora catchment area of eighty-five square miles, on which there are two sites for reservoirs, together with fifty-five square miles on the cap of the mountain range at Wingecarribee, on which there are two sites for reservoirs; the total storage capacity, including Prospect Reservoir, amounting to 116,337 million gallons, to meet the requirements of Sydney for the next twenty years, or up to the end of 1937, when, he estimates, there will be a population of 2,082,000, with a consumption per head per day of 63 gallons, the total estimated daily consumption being 131,207,000 million gallons.

Paris.

Academy of Sciences, September 3.—M. J. Boussinesq in the chair.—G. **Humbert**: Some properties of binary indefinite quadratic forms.—G. A. **Boulenger**: The classification of fresh-water fishes.—G. **Rémoundos**: The classification of the transcendental points of the inverse of integral or meromorphic functions.—P. **Dejean**: The classification of nickel and manganese steels. Steels containing less than 25 per cent. of nickel, giving a critical point at different temperatures on heating or cooling, and usually classified as irreversible, should be divided into two classes: from 0 to 10 per cent. of nickel, the perlitic steels, pseudo- or quasi-reversible, and from 10 to 25 per cent. nickel, martensic, and truly irreversible. The classification of manganese steels is also considered and some modifications suggested.—C. **Galaine**, C. **Lenormand**, and C. **Houlbert**: The economic utilisation of the peats of Chateauneuf-sur-Rance (Ille-et-Vilaine). The turf is submitted to a hydraulic press giving pressures of 50 to 100 kilograms per square centimetre, and the briquettes thus formed contain only 60 per cent. of water. These are heated in an autoclave for twenty-five minutes to a temperature of 160° C., and on leaving the autoclave are in a condition permitting of rapid air drying down to 25 per cent. of moisture. A recuperative arrangement for the drying is suggested.—A. **Cochain**: An attempt at an explanation of some peculiarities in the tectonics of the Alpine system.—J. **Mascart**: The winter of 1916–17.—A. **Goris**: The utilisation of *Esculus hippocastanum* (horse chestnut).

BOOKS RECEIVED.

Proceedings of the London Mathematical Society. Second Series. Vol. xv. Pp. liii+454. (London: F. Hodgson.)

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. iv. Part 1. (Sydney: W. A. Gullick.) 2*s*. 6*d*.

Ulugh Beg's Catalogue of Stars. Revised from all Persian Manuscripts existing in Great Britain, with a Vocabulary of Persian and Arabic Words. By E. B. Knobel. Pp. 109. (Washington: Carnegie Institution.)

Department of Marine Biology of the Carnegie Institution of Washington. Papers from the Department. Vol. xi. (Washington: Carnegie Institution.)

The Beginner's Psychology. By Prof. E. B. Titchener. Pp. xvi+362. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6*s*. net.

Human Physiology. By Prof. L. Luciani. Translated by F. A. Welby. Vol. iv., The Sense Organs. Pp. x+519. (London: Macmillan and Co., Ltd.) 21*s*. net.

Artificial Dye-Stuffs: Their Nature, Manufacture, and Uses. By A. R. J. Ramsey and H. C. Weston. Pp. ix+212. (London: G. Routledge and Sons, Ltd.) 3*s*. 6*d*. net.

Refractory Materials: Their Manufacture and Uses. By A. B. Searle. Pp. xii+444. (London: C. Griffin and Co., Ltd.) 15*s*. net.

A Concordance to the Poems of John Keats. Compiled and edited by D. L. Baldwin and others. (Washington: Carnegie Institution.)

General Types of Superior Men. By O. L. Schwarz. Pp. 435. (Boston, Mass.: R. G. Badger.) 2.50 dollars net.

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THURSDAY, SEPTEMBER 27, 1917.

EDUCATION REFORM.

Education Reform: being the Report of the Education Reform Council inaugurated by the Teachers' Guild. Pp. xxxii+215. (London: P. S. King and Son, Ltd., 1917.) Price 5s.

IT would be impossible to say much that is new on the subject of education. For three hundred years, at any rate, the objects, methods, and conditions of education from the nursery to the highest places at the university have been the topic of an unbroken and ever-increasing stream of essays, treatises, and newspaper articles. But here is a book in which everything of importance which has been spoken or written about education is reviewed and put into a new order. A national stocktaking is begun, and the Teachers' Guild has got to work with praiseworthy promptitude to provide for the systematic study of the present state of education in England and of the reforms which are needed. The result is the creation of a council to carry out its business. At the initiatory meeting in April, 1916, it was determined that this body should consist of a president (the first president is Sir Henry A. Miers), vice-president, treasurer, honorary secretary, and not fewer than thirty, nor more than fifty, additional members. But the council was given power to co-opt new members, and this power has been exercised so freely that the council is more than double the size originally contemplated. The wonder is that with so many cooks the broth has not been completely spoiled. The reports of the nine committees afford, however, quite interesting and instructive reading.

Readers of NATURE will naturally turn to the reports on university education and the secondary schools, and will look to the position which it is proposed to assign to natural science. Universities and schools have now got past the stage at which it is necessary to discuss the advisability of admitting natural science to a place in the curriculum, and, of course, there is no committee appointed by the Education Reform Council specially to consider what is admitted by the most conservative of "humanists." With regard to universities, it strikes one that while there is much that is admirable in the report, the committee is not strong enough in representatives of the old universities and of the provincial modern universities. It speaks too much from the London point of view. The report points out the desirability of a large increase in the number of students resorting to the universities, so that education of this type may become more commonly a normal part of the preparation for life, and that graduates should find their way more frequently not only into the professions, but also into active life in every direction. With regard to the view, hitherto so common among men of business in this country, that the "university man" has been by his very training at school and university unfitted for business, the report properly points out that graduates differ among themselves perhaps more than any other body of men with a common status. The universities attract a large proportion of the best ability of the country, and much of this ought to be utilised in directing industry and commerce. It should be added that the whole of it ought to be turned to account in one direction or another for the benefit of the country. The sporting landowner who knows nothing about agriculture and does not understand the management of his estate ought to disappear. In the direction of the definite application of science to industry there can be no doubt that there has been a great improvement of late years in the employment of university-trained chemists and engineers, and there is hope that the interests of agriculture will continue to get help in increasing degree from the universities.

As to school curricula, it seems as though the Committee on Secondary Schools had been too much under the influence of tradition or did not possess the boldness necessary to assign a due proportion of time to natural science in the time-table; for in the scheme suggested on p. 69 four hours a week is the maximum. Referring to the correlation of studies, the committee says:—"Training in expression, oral and written, should be given in connection with almost every subject in the curriculum, while the *methods of science* should permeate the whole course of study." The meaning of the words italicised here is far from clear. Correlation between literature and history, between physics and geographical phenomena, one can understand, but science here seems to mean logic, or at least common sense, which is obvious.

In all these discussions it is not sufficiently kept in mind that from the young student's point of view subjects are divisible broadly into—not literary and scientific, the usual antithesis—but "booky" and "non-booky." The former includes even mathematics, the latter means the study of things. There are minds which revel in the former, while there are others which the printed page seems to repel. Even among the latter it must not be forgotten that tastes differ. A young artist has been heard to say, "I enjoy looking at a flower, but when you begin explaining the uses of its different parts I lose interest in it." Young boys also, as a rule, love experiments of all kinds, but hate explanations, and, notwithstanding what has been said to the contrary, the curiosity of most children is soon satisfied, and it is only in later years that explanation of a fact or phenomenon has an interest equal to that of the fact itself. From all these considerations it follows that pupils should be classified not only according to age or as clever or stupid, but also according to the constitution of the mind and its inclination towards thinking or towards doing. The great principle for the teacher to remember is that, before all things, it is necessary to be interesting to the majority of the class. Without this neither rewards nor punishments will secure real attention. Now to be interesting requires that the subject should be well chosen and the teacher himself filled with the enjoyment of it. To secure this condition more commonly, teachers must be not only better qualified, but also better paid.

Dr. Garnett, chairman of the council, has written an interesting "Foreword" to this book of reports. He directs attention, among other things, to the fact that in some of the most important schools boys on the classical side still learn no science, and to the statements in the report he adds the remark that "the fate of a nation is not likely to depend on the appreciation of music, art, or literature by its rulers, but it may well hang on their appreciation of science." It is to be hoped that the British people, who seem for the present to be fairly well convinced of this truth, will act in conformity with it in demanding that the Government of the country shall no longer be officered exclusively from non-scientific sources.

These reports deal with a great variety of questions, among others with specialisation in schools and universities. In universities the specialisation should not be carried to such an extent as to sever all association with other studies, and especially is it important that science students should not abandon literary studies. Most students, it may be supposed, would shrink from doing so, if only for the sake of the mental refreshment which comes from history, fiction, or poetry in familiar use.

The subject of examinations is dealt with in a report all to itself. We do not now hear so much from the few enthusiasts who, at one time, were for doing away with examinations altogether. The committee says that the evils arising from examinations have been the subject of widespread complaint for half a century. That is true, but it is also shown that this is largely attributable to abuse or defects of the system which admit of remedy. And it is remarked that "in so far as examinations check initiative, it should be noted that candidates for professions whose initiative cannot survive the exact acquirement of the necessary knowledge are not well fitted by nature for such careers." The fact is that where initiative exists it will not be killed so easily. A comparison was made a few years ago between the D.Sc.'s of London University graduated under the original system of pure examination and those who from 1887 onward obtained their degrees on presentation of a thesis and were practically exempt from examination. Contrary to the expectations of those who advocated the change, greatly increased activity in the direction of research has not become manifest as a consequence (see NATURE for November 3, 1910, p. 30). W. A. T.

EXPERIMENTAL EMBRYOLOGY.

(1) *Three Lectures on Experimental Embryology.* By Dr. J. W. Jenkinson. With a Biographical Note by Dr. R. R. Marett. Pp. xvi+130. (Oxford: At the Clarendon Press, 1917.) Price 7s. 6d. net.

(2) *L'Œuf et les Facteurs de l'Ontogénèse.* Par Prof. A. Brachet. Pp. viii+349+xii. (Paris: O. Doin et Fils, 1917.) Price 6 francs.

THESE two volumes, although they deal with the same subject, are of very different character. Dr. Jenkinson's work aims at being a condensed compendium of the most recent results obtained in this division of zoology. Prof. Brachet's primer, on the other hand, gives a fascinating account of the gradual building up of our knowledge of the mechanisms underlying the development of the egg. He rigidly limits himself in this case to the instances necessary to illustrate his points. The substance of Dr. Jenkinson's book was delivered as three lectures in University College, London, and all zoologists will be grateful to Mrs. Jenkinson for publishing these lectures. Dr. Jenkinson was one of the many men of science who have sacrificed their lives on behalf of their country, but in the division of science which he represented his loss was felt as a peculiarly cruel blow, for experimental embryology has few representatives in England, and amongst those few Dr. Jenkinson was one of the most prominent. From the account of his life by his friend, Dr. Marett, which is contained in this volume, we learn that Dr. Jenkinson began his career in the university by the study of classics and of ancient philosophy, and that he was drawn to the study of biology, not primarily through the love of natural history, but because he regarded the study of the laws of life as the modern counterpart of the questions which had occupied the minds of the ancient philosophers. We can now understand a feature which puzzled many admirers of Jenkinson's "Experimental Embryology," published some years ago, viz. the disproportionate space allotted to the discussion of the views of Aristotle, a subject which to most biologists has only a meagre academic interest.

The volume before us suffers somewhat from being too much crammed with insufficiently digested details to form a textbook of the subject, and must be rather regarded as a sequel to the "Experimental Embryology" referred to above. The first lecture gives a general sketch of some types of embryonic development in order to illustrate the fact that growth, cell-division, and differentiation are the three cardinal facts in embryology which demand explanation. In the discussion of growth Dr. Jenkinson indicates his leaning towards Loeb's theory that growth is due to a chemical reaction, one of the products of which acts as a catalyser to expedite the reaction. This theory, like so many of Loeb's hypotheses, is at first sight attractive, but its entire value lies in its power to be applied in detail. Loeb used it to explain the supposed increase in nuclear matter, which he regarded as the most striking phenomenon of early development, but he measured the increased quantity of this material by counting the number of nuclei without taking into account the fact that the volume of the individual nucleus diminishes as development proceeds. This point is well brought out in a series of figures which Dr. Jenkinson gives.

The second lecture deals with the question of cleavage. A *résumé* is given of some of the more striking results of separating individual blastomeres from each other in different types of egg and allowing them to develop independently

of each other. It is pointed out that this separation gives rise to partial larvæ only, when, owing to the direction of the cleavage planes, different cytoplasmic substances are thereby separated from each other. We may note in passing that an error has been committed by Dr. Jenkinson in dealing with eggs showing the spiral type of cleavage. He states that the nephridia of the earthworm are derived from descendants of *2d* (an ectodermal cell), but those of the leech from cells which are daughters of *4d* (the mother-cell of the cœlomic mesoderm). The fact is that it was in the development of the leech that Whitman first demonstrated the ectodermal origin of the nephridia, and this was proved to be true for a near relative of the earthworm (Criodrilus) by Staff. In both cases *2d* or its homologue is the mother of the nephridia.

The third lecture has as its title "Differentiation," but it really overlaps to a large extent the second, and is occupied to a considerable degree with the potentialities of isolated blastomeres. The subject of the development of polyspermic eggs is then taken up, and the conclusion is reached that normal development is only possible if each blastomere into which the egg divides receives a full set of the reduced number of chromosomes. Dr. Jenkinson then considers the results of the cross-fertilisation of eggs of sea-urchins with the sperm of forms belonging to distinct genera, orders, and even classes, and arrives at the conclusion that the broad outlines of structure are inherited through the female, and that the male only hands on specific characters. This idea rests on the fact that the foreign sperm is unable to transmute the maternal cytoplasm into a being belonging to a totally different class. But although the cytoplasm has had its properties determined by the maternal nucleus during the ripening of the egg, yet the hybrid organism, which in most features conforms to the maternal type, never survives the early larval stage, at which period the "main features" of its adult organisation are not even indicated. There are also instances, such as the cross between Echinocardium and Echinus, where paternal influence can be detected at a very early period of development.

Dr. Jenkinson allows only a few pages for the most interesting department of experimental embryology, viz. the interaction of parts on one another—or formative stimuli. We can only heartily agree with his conclusion that this is a factor in development of the utmost importance, on which more work is urgently demanded.

(2) Prof. Brachet's little primer is one of the most fascinating volumes which we have ever read. The author was professor at the University of Brussels when the war broke out, but whether or not he is a Frenchman by race, he writes with all the clarity of thought and expression characteristic of the best French scientific men. He succeeds within moderate compass in giving a bird's-eye view of the principal results which have been obtained by the experimental method in embryology, without launching into unnecessary detail. His object is to answer, so far as our knowledge permits, two questions, viz. (1) How does the spermatozoon start the development of the egg? and (2) How is the development guided when it has begun?

With most of his conclusions we should be inclined to agree, and if we must demur to one or two of his deductions it is only fair to add that again and again he reminds us how imperfect is our knowledge in this department of zoology, how few are the types of eggs that have been experimented with, and therefore how provisional must be our theories. For this reason he will not even dignify them with the name of theories, preferring the more modest appellation "hypothèses."

It is natural that each writer on experimental embryology should give a large place to the results obtained from the type of egg with which he is familiar, and just as Driesch's thought has always centred in the sea-urchin's egg, so Brachet in this volume dwells principally on the frog's egg, with the development of which he has chiefly occupied himself. He arrives at the conclusion that the influence of the spermatozoon can be analysed into four separate actions. (1) It brings into the egg a centrosome which initiates the division of the egg nucleus. (2) By its union with the egg nucleus it restores the proper nucleoplasmic relation, and so enables the incipient tendency to divide to be carried through to a successful conclusion. (3) It causes a rearrangement of the organ-forming materials, and so determines the axes of symmetry of the embryo. (4) It transmits the special hereditary qualities of the father. Brachet holds the view, which, as we have seen, Dr. Jenkinson is also inclined to favour, that the main features of the embryo are determined by the cytoplasm of the egg, and are therefore purely maternal, all that is transmitted from the father being the smaller details which characterise his individuality. We have already indicated the reasons which compel us to dissent from this view.

Limits of space unfortunately forbid us to touch on many of the interesting points contained in the volume, such as the resolution of Driesch's entelechy into the results of surface tension, or the demonstration of the means by which polyspermy is prevented in normal development—which differ widely from Loeb's view on the same subject. We can only say, in conclusion, that a rich treat awaits the reader of this volume.

E. W. M.

OUR BOOKSHELF.

La Force et le Droit. Le Prétendu Droit Biologique. Par Prof. R. Anthony. Pp. 194. (Paris: Félix Alcan, 1917.) Price 2.50 francs.

PROF. R. ANTHONY, well known for his fine studies of arboricolous animals, and for his insistence on the evolutionary importance of an arboreal apprenticeship in the case of man's ancestors, has made an elaborate criticism of the view that there is biological justification for

the "Might is Right" doctrine. The argument against which the author advances somewhat heavy guns has been previously shattered by Dr. Chalmers Mitchell and others, but it is interesting to see it crumble under French fire.

According to the theory, the power of conquering in battle is the biological basis of Right, for does not evolution mean progress, and has not selection by means of struggle been the essential factor in evolution? To this Prof. Anthony replies: (1) that evolution is not necessarily a march in the direction of progress; (2) that the selection which results from intra-specific and inter-specific struggle does not appear to have more than an accessory *rôle* in evolution; (3) that the selection resulting from intra-specific struggle, even when this is competitive without actual combat, tends to accelerate processes leading to extinction (progressive specialisation and progressive increase in size), and does not necessarily increase the chances of victory in inter-specific struggle; and (4) that only that form of selection which results from vital competition without combat can help a species to a more complete realisation of its intrinsic tendencies, and that what gives the victory is not superiority in the power of destroying, but superiority in utilising the resources of life.

Prof. Anthony has not taken advantage, as he might have done, of some previous analyses of the various modes of selection, nor even of Darwin's insistence on the subtlety of the concept of the struggle for existence; but his own line of argument is interesting. As it seems to us, however, he pulls his bow far too tightly in his refusal to recognise the quality of "progress" in animate evolution, in his depreciation of the importance of natural selection, and in his theory that intra-specific struggle tends to accelerate processes that make for extinction. He exaggerates elements of truth until they become positively fallacious.

J. A. T.

Founders' Day in War Time. By Sir Adolphus W. Ward. Pp. 55. (Manchester: At the University Press; London: Longmans, Green and Co., 1917.) Price 1s. 6d. net.

MANY readers will be glad to have in this convenient and permanent form the address delivered by Sir A. W. Ward, formerly Vice-Chancellor of the University of Manchester, on March 23 last, at a memorial service for members of the University who have fallen in the war. After explaining the high office of education as "the drawing out, and bringing to a beneficent growth and increase, what has been implanted by nature, aided by circumstance," the address outlines the growth and development of Manchester University from the time when, in the year before that of the outbreak of the Great Civil War, Henry Fairfax petitioned the Long Parliament for the establishment of a northern university, down to the present day. The members of the University who study the address will value increasingly the privilege of their association with so worthy an institution.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Shell-shock and its Lessons.

IN NATURE of September 6 there appeared, under the enigmatic title, "The Psychopathy of the Barbed Wire," an exceptionally lengthy review of our little book on "Shell-shock and its Lessons." In it Sir Robert Armstrong-Jones makes no reference whatsoever to the main themes to which practically the whole of the book is devoted. These are, first, the vital importance, in dealing with cases of illness due primarily to specific anxieties and mental conflicts (whether these are caused by the terrifying experiences of warfare or the worries of civil life), of discovering the real nature and causes of these anxieties and conflicts; and, secondly, the urgent need for the establishment of clinics in which patients afflicted with mental disturbance can be treated while they are still sane.

This omission of all reference to the real substance of our book, to the topics with which it is primarily concerned from the first page to the last, is a curious commentary on the fairness of his review.

Instead of giving a real account of the scope of the book, he seizes upon a series of relatively unimportant points—so far as their bearing upon the aims of the work is concerned—and with almost unfailing regularity attributes to us statements which we have never made. As NATURE has given currency to these misrepresentations, we feel bound to ask for the opportunity of correcting them seriatim.

So far as the scientific readers of NATURE are concerned, we could confidently leave the inconsistencies of the review to tell their own tale; but the points at issue relate to far-reaching questions of public policy upon which action has to be taken by men who might perhaps be influenced and confirmed in their inertia by this review.

When we are accused of tending to dwell unduly upon the value of suggestion, hypnotism, and "psycho-analysis," we are forced to doubt whether your reviewer has read what we have said upon these subjects. For we took particular care to emphasise the strict limitations to the usefulness of hypnotism. Only two pages of our book deal with "psycho-analysis," and most of what we have written on the subject consists of a discussion of the various meanings of this term.

But why is no reference made by your reviewer to the vitally important subject of psychological analysis and re-education, to which a whole chapter is devoted?

As regards the question of dream-analysis, which we have also been accused of unduly emp[illegible] with the experience gained during the last three years in many hundreds of cases of "shell-shock" it is safe to say that the physician who does not analyse his patient's dreams in certain cases must inevitably fail to diagnose the real cause that is at the root of all the trouble. A typical instance has been reported in detail by Dr. W. H. R. Rivers in the *Lancet* of August 18, p. 237, and we could cite scores of similar cases from our own experience. Your reviewer's charge that we have dwelt unduly on dream-analysis can only mean that he is not acquainted with the important work that has been done in this field, and the extensive use that has been made of a measure proved to be quite invaluable for diagnosis and rational treatment.

We regret that Sir Robert Armstrong-Jones has so forgotten the amenities of discussion as to make the unwarranted statement that, "as stated in the introduction, the object of the volume is to rouse a feeling against the British attitude towards the treatment of mental disorder." We are living in busy times, but cannot a reviewer be expected to read at least the first three pages of a book with some care?

From the last-quoted statements the reviewer proceeds:—"Naturally, therefore, and also avowedly, the work is written for the general reader *and not for the medical practitioner*" (our italics). There is no excuse for this statement of your reviewer's, which is in direct conflict with the first paragraph of the introduction. There it is clearly stated that we were asked by members of the medical profession to write the book, for whom it is obviously and primarily intended. But if your reviewer is inclined to say on behalf of his professional brethren, "Lord, we thank Thee that we are not as other men," we might refer him to a leading article in the *Lancet* of September 1, pp. 352–53, in which the opposite point of view is expressed in no uncertain way.

Again, reference is made to our "constant effort . . . to convince the public of the necessity for reform in the treatment of the insane . . . which does not appear to follow as a corollary from a disquisition on shell-shock." As we have already pointed out, the main purpose of the book is to appeal for the reform in the treatment (or, perhaps it would be more correct to say quite frankly, an *appeal for the treatment*) of incipient mental disorder in patients *while they are still sane*. Further, on the first page of our book we explained why we used the popular and official term "shell-shock," and directed specific attention to its inadequacy; moreover, on the second page of the introduction we pointed out that "the problems of shell-shock are the everyday problems of nervous breakdown."

What we have already mentioned in this letter, and urged again and again throughout the book, is that the war has forced us to adopt measures for the treatment of such troubles, and that the lessons so learned ought to compel those in authority to provide for civilians afflicted with nervous breakdown facilities such as have been proved to be so eminently successful in the case of soldiers.

Your reviewer's disquisition on heredity, viewed even from the purely logical point of view, is so self-destructive that we are sorely tempted to leave it as it stands; but as he once more imputes to us statements which we did not make, we are forced to direct attention to them.

In our discussion of the bearing of the question of heredity upon the problems of insanity (chap. iv.) we did not compare the heredity of tuberculosis with that of insanity, as your reviewer claims, but the *attitude of the public towards* this question—a vastly different matter. We speak also (p. 78) of "an attempt justly to appreciate the relative influence of heredity and environment in the case of tuberculosis." Your reviewer's paraphrase of this is, "the authors are men of science who deny that there can be a true inheritance of any microbic disease"! This is a not unfair sample of the methods he has adopted consistently throughout his truly remarkable review.

Arguing in favour of the hereditary factor in the production of shell-shock, he claims that, after digging into the family histories of his patients three generations back for a history of "insanity, epilepsy, paralysis, neurasthenia, or parental alcoholism," he got a positive result in 33 per cent. Might we ask Sir Robert whether it has occurred to him that this implies a negative result in 67 per cent.? Moreover, among his 33 per cent. does he ask us wholly to eliminate, as a causal factor in producing neurasthenia, the influence of the worries and emotional disturbances produced by the social environment upon those who have to live with a drunkard, an irritable neurasthenic, or a lunatic?

"In the absence of this information" (of some neurotic affection in three generations), he says, "it would be incorrect to state that shell-shock cases presented no neurotic family history." We agree, but who made so strange a statement?

If your reviewer's statements on this point have any meaning, it must be the unworthy insinuation that shell-shock is in some way due to heredity. It is true that in 67 per cent. of his cases he was unable to bring into his widely spread net of hereditary influences (assumed to be contributory) any trace of the causal factors to which he quite gratuitously pins his faith. Every reader of Nature must be personally acquainted with some soldiers suffering from shell-shock, and among them men who before the war were the strongest, bravest, most daring, yet level-headed, members of the community, and with a clean and untainted family history. These are the men against whom Sir Robert Armstrong-Jones makes his unfounded insinuations. These are the men who are said to belong to those psychopathic breeds with "some deeply ingrained defect only curable by extinction of the stock or by its repeated crossing with other more stable stocks"!

What possible justification can there be for branding with this wholly undeserved stigma some of the best and noblest members of our race?

Yet these dogmatic claims are made by your reviewer just after he had confessed that "we have no definite knowledge of what is inherited"!

There are still, however, some more statements "to nail to the counter."

The writers of the book did not claim, as your reviewer says they did, that "there is no anatomical evidence . . . in the cases of psychoneuroses *which they had treated*" (our italics). Our reference (p. 87) was to those cases of psychoneurosis *which yield to psychical treatment*—an entirely different matter.

We fully agree with the remark:—"That shell-shock is entirely of psychic origin and can be overcome by psycho-therapeutics is too sweeping a statement." We do not know who is responsible for this statement, but we certainly did not make it.

If we "appear to underrate . . . the implications connected with physical changes," we hasten to remove such a mistaken impression. But we suspect that your reviewer somehow omitted to read pp. 7 and 8 of our book, in which we not only mention these matters, but also refer our readers for further information to Prof. Cannon's important book on "Bodily Changes produced by Fear, Pain, Hunger, and Rage."

In thus reviewing the review on "Shell-shock and its Lessons," we have confined ourselves (except in the first paragraph) to the issues raised by the critic, who has succeeded in misrepresenting our book with such consistency.

In conclusion, however, may we be permitted once more to repeat that the chief plea of our book has been entirely ignored in this lengthy review? That plea is for the institution of clinics (attached to general hospitals and medical schools) in which sufferers from the milder and early stages of mental disorder may be studied and treated, and thus be helped *before, and not only when*, they have become so deranged that internment in an asylum is necessary

Our book is a real attempt to suggest a remedy for a grave social evil, and measures for the advancement of knowledge and for scientific research. Whether our suggestions are wise or the reverse, at any rate the problems they deal with are of vast importance and worthy of serious consideration. The evil we are

attacking is inertia, the acceptance of theoretical views which in practice mean doing little or nothing, either to cure patients or to add to knowledge. According to the reports of the Commissioners in Lunacy, the recovery-rate of mental diseases in this country is to-day no higher than it was in the seventies of last century. Are we then to rest satisfied with the pessimistic appeal to "heredity," when even those who use this as an excuse for their inertia admit that "we have no definite knowledge of what is inherited"?

G. ELLIOT SMITH.
T. H. PEAR.

The University of Manchester, September 12.

THROUGH the courtesy of the editor of NATURE I have had the opportunity of reading the long comment made by Prof. Elliot Smith, the distinguished anatomist, and by Mr. T. H. Pear, the equally able psychologist, upon my review of their little volume entitled "Shell-shock." As was pointed out, the authors show a lack of practical knowledge of the law as applied to the insane, yet they assert that the main object of the essay is to secure a change in the statutes in order to provide the establishment of clinics in which, to use their own words, patients "afflicted with mental disturbances can be treated while still sane," a problem with contradictory implications, but which is interpreted in the introduction to be "the painful probing of the public wound, the British attitude towards the treatment of mental disorder." As has been stated in the review, this was a corollary that did not seem to follow from the essay, a view also shared by the *Spectator* (September 1), which says that "the authors' assumption, by the way, especially after the statements quoted from the first chapter that the unfavourable termination of shell-shock will be insanity, seems to us somewhat gratuitous." One of the reasons given by the authors for seeking a change in the law is the fact that doctors in British asylums have no adequate knowledge of psychiatry to enable them "to co-operate with the medical schools and the teaching staffs of general hospitals." I claim to be fairly intimate with the knowledge of mental diseases possessed by asylum physicians in this country, and I agree with the two authors' view of their own criticism, viz. that it is well open to the charge of being "superficial, uninformed, and even spiteful" (p. 115), although it is graciously allowed that "there are exceptions to this general statement."

The first pre-requisite in a review is to ascertain the author's opinions upon fundamental facts, and the treatment described in this volume is based upon the authors' views of the hereditary transmission of disease and of the relationship between mind and matter; and because they regard the psychic as the predominant partner, they practically ignore the physical treatment of shell-shock and dwell at length upon the psychic remedies; no adequate place is given in etiology to physical weariness, fatigue, exposure, exhaustion, and the various forms of toxæmia, but an almost exclusive place is given to psychic trauma. The reviewer is criticised for not referring at length to psychological analysis and re-education, but as these are the acknowledged methods employed by all investigators into mental disturbances and are not original, they needed no special elaboration. The reviewer has long taught in his clinical class that the elementary procedure in the treatment of mental cases has been along the lines of the three "E's," viz. explanation, education, and encouragement. In regard to dreams, all psychiatrists realise the occasional help obtained from the latent dream, but the key of interpretation of the manifest dream depends upon the varying code vocabularies employed, and at the moment a certain school is inclined to lay inordinate stress (in the reviewer's opinion) upon the interpretation of dreams, yet it is the vogue, and this, like other fashions, is entitled to its day.

The authors quote with some surprise my record of 33 per cent. of shell-shock cases with a neurotic family history, and erroneously conclude that the remaining 67 per cent. furnish negative evidence of heredity. As the reviewer pointed out, it would be necessary to ascertain the full family history in each of the remaining cases for at least three generations—which would be impossible—before these percentages could be considered to be trustworthy negative evidence; and at best the pedigrees obtained by the clinician are of the most brief and meagre kind. The authors consider it to be a social stigma to belong to a neurotic family, heedless of the fact that the neurotic people do the work of the world, and in startling contrast to the quip of a leading psychiatrist that he would rather be the offspring of a lunatic than of a churchwarden! The authors are eager to proclaim that the essay was written for the medical as well as the lay reader, and the reviewer accepts the correction whilst adhering to the view expressed that it will be most interesting reading for the latter, although rather "thin" stuff for the former.

When critics are at bay and without missiles of offence, a favourite device is the *ignoratio elenchi*, or the fallacy of the irrelevant, which then becomes a welcome weapon, and the authors conclude their comment by endeavouring to hold up the reviewer to obloquy because he had ventured to suggest a *locus resistentiae minoris* in the victims of shell-shock.

ROBERT ARMSTRONG-JONES.

The Convolvulus Hawk-moth.

HITHERTO *Sphinx convolvuli* has been reckoned one of the rarer insects in Scotland. In the last fifty years I know of only two authentic records of its occurrence in Wigtownshire; but this autumn it is abundant. One came into my house on September 7; a correspondent in Perth, a well-known entomologist, tells me that he has examined eight specimens taken in that neighbourhood, and a lady in this county, also a trustworthy observer, counted seven of these fine insects hovering round tobacco plants in her garden and darting their long probosces into the flowers. It is difficult to imagine the cause of the appearance of these moths in such numbers after many years of absence.

The immensely increased area now under potatoes might be expected to result in a corresponding increase in the number of death's-head moths. Unfortunately, however, the habit of all the Sphingidæ is to pass the pupa stage buried in the ground, which, in the case of the death's-head, is cultivated land, and the great majority of pupæ are destroyed in the course of tillage.

HERBERT MAXWELL.

Monreith, September 22.

Vitality of Lice.

I HAD occasion recently to examine microscopically some head-lice (*Pediculus capitis*) under water, and I noticed a phenomenon to which I have been unable to find any reference in standard works.

On first being placed into water contained in a watch-glass the lice struggled, but after a short time there was no activity visible, and life appeared to be extinct. After three-quarters of an hour I poured out the water from the watch-glass and dried the lice. In a few seconds they showed manifestations of life, and within a minute resumed their normal activity, internal metamorphosis and metabolism being visible. This led me to further experiments, and I find that after

being submersed completely for fifteen hours in a beaker of distilled water free from air, they regain their normal activity within a quarter of an hour of their removal from water. I have not yet tried submersion for longer periods, but the subject is of great interest, and I should be obliged if any of your readers are able to throw any light upon it.

HENRY COHEN.

"Avenue House," Petworth Street, Cheetham, Manchester, September 2.

THE AUTUMN MOON.

LUNAR theory has become recently an engrossing study for all, and is not to be classed such a useless abstraction as before. The peculiar behaviour of the autumn full moon in our high latitudes has always attracted the attention of the hunter and farmer, and given it the name of harvest or hunter's moon, according as it comes next before or after the equinox.

This behaviour, which has attracted attention and given the name, will be on view at this full moon; it will be noticed how the time of moonrise will be very nearly the same during the inside of a week, the full moon coming up at sunset, or a little before or after.

The full moon on this September 30 is, then, strictly speaking, the hunter's moon, but may also be called the harvest moon in this backward season. The previous full moon of September 1, coming a month before the equinox, did not show up so clearly to a noticeable extent the peculiarity of a successive rising at sunset, with little or no delay.

The astronomical explanation is simple. At the autumnal equinox the full moon is passing through the ascending node of the ecliptic at the vernal equinox, and its motion from south to north of the ecliptic is quickest.

The usual retardation of rising due to the moon's motion along the ecliptic is diminished by the rapidly northing motion, and the effect is to reduce the retardation from an average forty-eight minutes daily in a month of thirty days to something considerably less, especially in high latitudes, where the retardation may sometimes be wiped out altogether, and the moon will rise earlier for a night or two. The same effect of diminished retardation takes place every month, while the moon is moving through the vernal equinox; but the effect passes unnoticed, as the moon is not full.

We begin by taking the moon to move in the ecliptic, but her orbit is really inclined at about [illegible]e degrees, and the nodes of the orbit revolve in eighteen years. The effect is not the same, then, every year, but greater or less; and the modification can be investigated on astronomical theory from the numerical data of the Nautical Almanac. In some conjunctions it will be possible to see the full moon travel round the horizon, in a latitude five degrees short of the Arctic Circle, as in the northern parts of Sweden.

The effect is reversed and the retardation of rising is greatest when the moon passes through the autumnal equinox and is receding most rapidly from the pole star, as in the last old and new moon a fortnight ago.

The full moon at the vernal equinox will rise, or set, from an hour to an hour and a half, or two hours, later each night, and advantage can be taken if moonlight is to be avoided.

The words in "Macbeth," "The moon is down . . . And she goes down at twelve. I take 't, 'tis later, sir," would imply a moon about a week old, and moving through the autumnal equinox, making midsummer the time of the play. Shakespeare's education has been called in question, but he can always be relied upon for accurate observation, and is not content to take his natural philosophy out of a book, second-hand and unverified.

The moon is full in passing through the autumnal equinox when the sun is opposite in the vernal equinox—that is, in spring. This full moon will be observed to be very late in getting up and in setting again; but it has not attracted attention, as unconnected with any influence on human life.

It may be called Endymion's moon, from the legend of Mount Latmos, where we may suppose Endymion, an astronomer, had built his observatory within reach of Miletus. In the legend he drew the moon goddess down by the arts of a Thessalian witch, and in the springtime would not let the goddess go in a hurry. The scene has been utilised by Hardy in "Two on a Tower."

Mount Hamilton, with the Lick Observatory on it, resembles Latmos in being within reach of San Francisco. The journey there is a favourite pilgrimage and, in contrast to our Greenwich, visitors are encouraged to cheer up the solitude of the staff, and provide merriment after they are gone by their innocent questions. One Lund divinity visitor was reported to take a great interest in the life of young Endymion, and curious of his habits, she asked, "What do you do all night?" "We take the observations." "What do you do all day, then?" "We reduce the observations." "But why cannot you take your observations the right size once for all?"

The erratic behaviour of the moon in the sky has been a pitfall for artist and poet; the mistakes have provided much amusement to the astronomer. Turner, the artist, has painted the sun setting in the east in his picture of the old *Téméraire*. Hogarth's picture of "The Lady's Last Stake," now gone to America, in which Mrs. Thrale claimed to have sat for the lady's model, is intended to draw a moral on sitting up gambling all night, with the moon looking in reproachfully at the window. But the astronomer recognises a winter new moon, and the hour is about five o'clock tea time, so we may imagine the other members will be knocking at the door and asking, "When are you two coming in to tea?"

We still speak of new moon and old, and so perpetuate the ancient theory of Pythagoras that the moon is not a celestial body coming round every month, but a sort of magic lantern shown on the sky. This doctrine of Pythagoras is still

the orthodox theory in Turkey to-day, and to prove it, the national emblem of the Crescent shows a star shining through the moon; and Coleridge, in the first draft of "Christabel," is reported to have seated a star in the horns of the crescent.

The sun and moon go round like the hands of a clock, hour and minute, on the old Chaldæan estimate of a year of twelve lunations of thirty days. Full moon would occur when the two hands are in lines directly opposite.

A sundial, marked to serve as a moondial, like the old dial at Queens' College, Cambridge, will give forty-eight minutes added to moonlight time for every day of the moon's age, to give the corresponding sun time on the average.

A moon clock of greater accuracy and variation is required to mark the time when the moon is down longer than usual, drawn down in the legend by Thessalian arts, when the witch loves to ride through the air in the dark.

In "All for Love; or, The World Well Lost," Dryden writes:

> Her eyes have power beyond Thessalian charm
> To draw the moon from heaven,

and this was considered just the time for us to be most on our guard, during the coming winter; although this expectation has not been realised of late.

In ancient astronomical lore as well as in poetry, the sun and moon were pictured as living bodies, and an eclipse could be described as drawing them down to earth, the moon and sun.

Prior information of an eclipse was of great service to counteract superstitious fear, and to claim the magic power as on your own side; as in the case of the solar eclipse predicted by Thales, related by Herodotus, occurring in the middle of an important battle.

A lunar eclipse is so common as to attract little attention to-day; the frequent occurrence compared with a solar eclipse attracted the attention of Aristotle. But the lunar theory involved could be utilised by the Thessalian magician, and would have proved valuable to the Athenian general Nicias in his disastrous retreat from Syracuse.

G. GREENHILL.

THE RESOURCES AND PRODUCTION OF IRON AND OTHER METALLIFEROUS ORES.

IN order to meet what has apparently been a want both to those engaged in the iron and steel industry and to those who are interested in obtaining knowledge of the mineral resources on which the industry mainly depends, the Advisory Council for Scientific and Industrial Research has thought it desirable that a report[1] should be compiled summarising the latest information available regarding the iron-ore resources of the United Kingdom, as well as those of other countries. Although a vast amount of information has been published from time to time, it exists mostly in the form of reports and monographs scattered throughout the Proceedings of technical and scientific societies and in the very valuable publications of the Geological Surveys and Mines Departments of this country and of the principal Dominions of the British Empire; also in those of other countries, particularly the United States. Consequently much time and labour have to be spent in searching for the literature on the subject.

The aim of the report, therefore, has been to collect and present in a summarised form the main facts concerning the resources of iron ores and of other metalliferous ores accessory to the metallurgy of iron and steel, and to indicate their composition and character, giving as many analyses as possible of the minerals in every locality, with indications as to their geographical position and accessibility. The report is the work of Mr. G. C. Lloyd, the secretary of the Iron and Steel Institute, and it has been revised and added to by Prof. Henry Louis, of the Armstrong College, Newcastle-upon-Tyne.

The report is divided into three main parts, of which Part i. deals with the iron ores of Great Britain and Ireland and of the British Dominions. It is known that large resources of iron ores exist in the United Kingdom, but in certain districts, owing to their mode of occurrence, as well as the low percentage of iron which the ores contain, it has been difficult to work some of them profitably. Foreign ores, especially those of Scandinavia, which are of high-grade quality, have been imported so cheaply into this country that the native lean ores could no longer compete with them. Native ores have therefore to a great extent been disregarded, and expenditure upon their development has not been worth while on account of the ease with which cheap supplies of much superior ore could be obtained from abroad. The ores of the United Kingdom are described in approximately the following order:—

(a) Red and brown hæmatites and magnetites (Cumberland, Lancashire, Cornwall, Devonshire, and the Forest of Dean), and the aluminous ores of Co. Antrim, Ireland. These are estimated at about 500 million tons.

(b) Carbonate ores or ironstones (Cleveland, Northamptonshire, Rutlandshire, and Leicestershire), and the calcareous ores of the Lower and Middle Lias (Lincolnshire, Oxfordshire, Wiltshire, and Somerset). Reserves of these are estimated at about 5000 million tons, but it is thought that probably this figure is too low. Both in Cumberland and Northamptonshire new developments in iron-mining are now taking place on a considerable scale. Some attention has also been lately directed to the Cornish iron ores, but it is extremely doubtful whether these can be worked again upon any important scale.

(c) Stratified iron ores of the Coal Measures (Scotland, Northumberland, Staffordshire, Derbyshire, Shropshire, and South Wales). Reserves of these are estimated at about 34,000 million tons. In normal times by far the largest proportion of the above quantities cannot be worked with profit.

[1] Department of Scientific and Industrial Research. Advisory Council. (London: H.M. Stationery Office.) Price 2s. net.

As regards the production of iron ore, the total amount raised in 1913 was just under 16 million tons, to which Cleveland contributed nearly 6, Northamptonshire 3, Lincolnshire 2·6, and Cumberland 1·3 million tons. The above total compares unfavourably with the output in 1880, which was above 18 million tons. Scotland, which then contributed 2·66 million tons, only produced 0·59 million tons in 1913. Staffordshire also shows a big decline. On the other hand, imported ores had risen from 3 million tons in 1880 to 8 million in 1913, of which 4·7 came from Spain. Thus some 24 million tons of iron ore were raised and smelted in 1913, of which slightly above one-third came from abroad. A total of 10·26 million tons of pig iron was produced, representing an average iron content of 42·7 per cent. in the ore.

The resources of the British Dominions are then referred to, the principal deposits at present known being those of Newfoundland, Canada, India, and Australia. Two of the largest iron mines in the world are situated on the north-western shore of Bell Island, Newfoundland, and from them the Canadian iron industry has drawn its chief ore supplies. Immense resources of iron ore are known to exist in India, but no definite estimate of the quantities available for exploitation has ever been made.

Part ii. gives information of the same kind and so far as it is available with regard to most of the other countries of Europe, Africa, Asia, and North and South America. As regards the iron-ore deposits of the United States, the economic and industrial conditions render it unlikely that those ores will ever be imported into this country. So far as the iron industry of the United Kingdom is dependent on the iron resources of other countries, any supplies drawn from the United States will probably always be in the form of pig iron or semi-finished and finished iron goods.

In Part iii. notes are given of the principal uses, occurrence, and composition of the ores of metals other than iron but used in the iron industry—viz. chromium, cobalt, manganese, molybdenum, nickel, titanium, tungsten, vanadium, and zirconium, including references to the composition of ferro-alloys manufactured from some of these ores.

THE EFFORTS OF FRENCH INDUSTRY DURING THE WAR.

WHILE the various Allied countries are busily occupied in discussing elaborate after-war programmes, there is evidence that France at least has passed the domain of mere theoretical speculation. The Société d'Encouragement pour l'Industrie Nationale recently organised at its headquarters in Paris an exhibition of national industries, the exhibits comprising: (*a*) products manufactured in France since the outbreak of the war, and which prior to the war were all—or nearly all—obtained from abroad; (*b*) products which before the war were manufactured principally in the regions now in enemy occupation and are now manufactured beyond the French Army zone. A description of the exhibits is given in the July-August number of the society's *Bulletin*, and the following brief notes refer to the products of a more or less scientific character.

Quartz and Glass Goods.—MM. Adnet and Poulenc Frères exhibited a comprehensive series of glass and quartz vessels used in chemical and bacteriological work, including some specimens of "tuboserum" glass which M. Adnet has manufactured to replace the neutral Jena glass. Other exhibits included Dewar bottles, nitrometers, gas determination apparatus, clinical thermometers, and a microscope the optical and mechanical parts of which were made entirely in France. Special interest attached to the exhibit of a Coolidge tube, which has now assumed importance in connection with the radiography of metals.

Chemistry.—At the outbreak of war France was practically entirely dependent on Germany or on German-owned companies for her supplies of chemicals necessary for the manufacture of high explosives. The war has changed all that, as is evident from the long list of organic compounds shown at the exhibition now under discussion. A comprehensive series of samples of the coal-tar derivatives was shown, as well as samples of synthetic nitric acid and nitrates obtained from French works. Again, the French have taken up in earnest the manufacture of pharmaceutical products which were essentially German specialities before the war (aspirin, local anæsthetics, hypnotics, etc.), as the list of exhibits shows. Many compounds used in the manufacture of dyes, varnishes, etc., and in connection with photography and radiology were shown. Progress has also been made in the manufacture of compounds of the rare earths, which in peace time were obtained exclusively from Germany, while pure cerium, ferro-cerium, and magnesium (manufactured for the first time in France) have now passed the experimental stage. Three novelties in the way of chemicals were represented in synthetic acetic acid, synthetic acetic anhydride, and synthetic alcohol.

Miscellaneous.—Ebonite, so largely used in scientific instruments of all kinds—especially electrical—had to be obtained from German firms by France at the outbreak of war. Many samples of ebonite goods were included in the present exhibition, and it is hoped that France may after the war be self-supporting in this respect. The French are also taking up actively (as we are in this country) the manufacture of magnetos, and it is hoped, with the advent of better labour conditions, to replace foreign-made goods by the French article.

It would be highly interesting and instructive from the economic point of view if British manufacturers of articles similar to those described organised a comprehensive exhibit on the lines indicated above. The country would then at least know that serious attempts were being made to take action rather than spend time in abstruse arguments which have little value except for the theoretical economist.

E. S. Hodgson.

NOTES.

MUCH has been said lately about the commercial possibilities of aircraft after the war, and the question of an aerial post has been discussed by a responsible committee; yet to the man in the street such a proposition seemed to be rather far-fetched. The splendid flight made on September 24 by Capt. Giulio Laureati from Turin to London was a most practical and striking demonstration of the possibilities of the use of aircraft, and could scarcely have come at a more appropriate time. Capt. Laureati flew the whole distance of 650 miles without descending in seven hours and twenty minutes, a speed of eighty-nine miles per hour. The wind was adverse, so that the actual flight speed was above this figure. Letters were carried, including one from the King of Italy to our own King; and the Italian morning papers were delivered in London in the afternoon. A more direct proof of the practicability of the rapid delivery of light articles over long distances by means of aircraft could scarcely be imagined. The machine flown was one built by the Società Italiana Aeroplani, fitted with a Fiat engine, a similar machine to that on which the same pilot previously flew 920 miles without stopping—from Turin to Naples and back. The present flight is the longest "international" flight yet made, and the pilot met with a very warm reception at Hounslow, where he landed, and where he was met by representatives of the Air Board, the Admiralty, and the War Office. Capt. Laureati deserves the highest congratulations on his splendid feat, and it is to be hoped that this flight marks the commencement of a new epoch of rapid transit from country to country by means of aircraft, with a corresponding benefit to international trade.

THE August issue of the Proceedings of the U.S. National Academy of Sciences contains reports of the meetings of the Executive Committee of the National Research Council since April 4 last. At the meeting on June 21 it was announced that the Carnegie Corporation of New York had authorised a grant of 10,000*l.* to the Carnegie Institution of Washington for purposes of the National Research Council, with the understanding that disbursements on account of this donation should be made at the discretion of the president of the institution. The committee appointed to consider the question of the organisation of State research committees and their relation to the National Research Council recommended that a letter offering the complete co-operation and assistance of the National Research Council be sent to those State councils which have already organised research committees, and that a letter be sent to the proper officer of all the State councils of defence which have not already organised research committees pointing out that the National Research Council has carefully considered the question of the general organisation of State committees or councils of research, and has come to the conclusion that such organisation should be determined by local needs and conditions. Local causes, such as the development or investigation of natural resources or the proper development of the use of research methods in industries, or the correlation of industries with research laboratories already existing at educational institutions, may make it very desirable to organise such State research committees. In fact, the present emergency offers, in some respects, an unusual opportunity for improving the correlation of industry and research, and it is highly desirable that those concerned with this development should not only consider it with reference to the emergency, but should also plan for the permanent continuance of any research committees which may be formed.

A REPORT presented at the Newcastle meeting of the British Association last year directed attention to the lack of organisation and general neglect of higher geodesy in the United Kingdom. The discussion upon this report led to the extension of the terms of reference of the committee so as to include, in addition to geodesy, other departments of geophysics, such as terrestrial magnetism, tides, atmospheric electricity, and seismology. It was felt that steps should be taken to constitute a committee or association to promote the advance of the various branches of science which deal with the physical, metrical, and dynamical properties of the earth, on both their theoretical and observational sides. We are glad to learn that such a committee has been appointed by the British Association and has arranged meetings for the discussion of geophysical subjects. The first meeting will be held in the apartments of the Royal Astronomical Society on Wednesday, November 7, at 5 p.m., and will be presided over by the chairman of the committee, Sir Frank W. Dyson, the Astronomer Royal, who will make a brief statement concerning the objects and future programme of the meetings. The subject of magnetic surveys will be introduced by Dr. S. Chapman, who will make a report on magnetic surveys and charts by land and sea throughout the world. Dr. G. W. Walker will give an account of the recent magnetic survey of the United Kingdom made under the auspices of the Royal Society and the British Association. Major Lyons will exhibit and describe two of Gauss's heliotropes, on loan to the Science Museum. At the second meeting, which has been provisionally appointed to take place on December 5, Prof. A. Schuster will preside, and Sir Napier Shaw will open a discussion on the general constitution and condition of the atmosphere, which will be continued by Mr. J. H. Jeans and others. Among the subjects which the committee has under consideration for report and discussion at later meetings may be mentioned seiches and tides; atmospheric electricity; British earthquakes; observatories; methods and instruments in connection with the various branches of geophysics; geodetic and gravity surveys; and the constitution, temperature, and other physical conditions, motions, and secular changes of the interior of the earth. Papers on these and other geophysical subjects for reading and discussion at the meetings, as approved by the committee, should be addressed to Dr. S. Chapman, secretary of the committee, Royal Observatory, Greenwich, S.E.10.

THE post of Director of Food Economy at the Ministry of Food has been undertaken by Sir Arthur Yapp, the national secretary of the Y.M.C.A.

THE seventh Norman Kerr lecture of the Society for the Study of Inebriety will be delivered by Major W. McAdam Eccles, on Tuesday, October 9, at 5.30 p.m., in the Robert Barnes Hall, 1 Wimpole Street, Cavendish Square, London, W.1. The subject will be "War and Alcohol."

DR. G. T. WALKER, Director-General of Observatories, India, informs us that in view of the uncertainty of postal arrangements, and in order to save space on shipping, it has been decided to discontinue sending the publications of his department out of India during the continuation of the war.

THE death is announced, at fifty-six years of age, of Mr. R. D. Pullar, president of the Society of Dyers and Colourists in 1914, and chairman of the well-known firm of Messrs. J. Pullar and Sons, dyers and cleaners, of Perth. Mr. Pullar was a life fellow of the Chemical Society of London.

THE Geological Physics Society has arranged a museum demonstration on "Pseudo-Fossils, or Lusus Naturæ," at the British (Natural History) Museum,

South Kensington, in the Geological and Mineral Galleries, on Saturday, September 29, at 3 p.m. The demonstration will be conducted by the acting honorary secretary of the society, Mr. W. F. Gwinnell.

WE regret to record the death of Mr. F. O. Erichsen, which is reported by cable from Buenos Aires. A brief account of his career appears in *Engineering* for September 21. He was educated at Rugby School, and after pupilage with Messrs. James Simpson and Co., of London, became chief of their outdoor erection department, in which capacity he was responsible for the erection and duty trials of many large pumping plants, both at home and abroad. Mr. Erichsen was appointed a director of his firm in 1914, and was an associate member of the Institution of Civil Engineers, and a member of the Institution of Mechanical Engineers.

WE regret to note that *Engineering* for September 21 records the death of Mr. B. W. Head, on September 12, in Orange River Colony, at the early age of forty-two. After serving an apprenticeship to engineering, Mr. Head went to Cambridge, where he took a double first-class in the Mechanical Science Tripos. The work of his firm, Messrs Jeremiah Head and Son, was chiefly connected with steel-works plant, and Mr. Head took an active part in developing this work, both in this country and in America. He was a member of the Institution of Civil Engineers and of the Iron and Steel Institute.

DR. ADDISON, Minister of Reconstruction, delivered an address on September 22, in the Town Hall, Huddersfield, on "Social Reconstruction after the War." He insisted that in the past this country has not made enough use of brains. How highly trained, scientific men have overcome the difficulties of supplying our armies can never be sufficiently described, and yet before the war those men had been paid salaries, in some cases by people who ought to have known better, that were a disgrace to the community. One lesson of the war has been that it pays to employ brains and to pay for them properly. Later Dr. Addison emphasised the need for a closer association between the laboratory and the factory. Science must be brought more into industry. One of the chief reasons why the Germans invaded our markets is that they organised their buying and selling on comprehensive lines. We must do the same. The steps being taken will remove some of the difficulties in respect of our commercial intelligence. As a whole, we get what we pay for. When men in this work are paid about the wages of clerks we get value for what we pay, but we do not get what we want. Dr. Addison went on to explain that he had had prepared a precise and scientific examination of great groups of factories in this country which shows how efficient plant, method, and management yield striking results as compared with places where those conditions do not prevail. In one case, although wages had increased 20 per cent., the cost of production had fallen by 29 per cent.

DR. A. W. BISHOP, who died at Nottingham on September 9, was born at Highgate on November 25, 1867. He received his early education at Highgate Grammar School, and later, at the Royal School of Mines, showed a distinct ability in chemistry. From 1887 to 1890 Dr. Bishop worked in the laboratory of the late Prof. A. von Baeyer in Munich, and obtained the degree of Ph.D. "magna cum laude." At Munich he worked chiefly under the direction of Claisen, with whom he investigated the preparation and reactions of *d*-oxymethylenecamphor, and his thesis, "Ueber den Formylcamfer," was the result of work carried out with extreme care and ability. In 1890 he became assistant to Prof. W. H. Perkin at the Heriot-Watt College, Edinburgh; and in February, 1894, he took up the appointment of professor of chemistry in H.H. the Maharaja's College, Trivandrum, Travancore, S. India. He later became principal of the college, and in 1911 was appointed Director of Public Instruction, from which post he retired in 1915 on account of ill-health, having completed rather more than the ordinary full-time service. On returning to England, he worked under Prof. W. J. Pope in the Cambridge University Chemical Laboratory, and later joined the research department of Sir Jesse Boot at Nottingham. It was always a great disappointment to Dr. Bishop that his position in Travancore did not give him any facilities for continuing research work, and he looked forward to taking up chemical investigation again after his retirement. For the greater part of his time in India his work largely consisted in directing first collegiate education, and later the whole of the Education Department in Travancore was under his control. He also did a considerable amount of work for the University of Madras, of which he was a fellow, a member of the Senate, and a member of the Board of Studies in Physics and Chemistry. During the short time that remained to him after leaving India, Dr. Bishop was engaged in the research which he so greatly loved, and less than a week before his death, in a letter to the present writer, he expressed unabated enthusiasm for his work. His connection with India brought him many friends, and whilst they regret his sudden death, they will always remember him with sincere affection and esteem.

IN *Folk-Lore* (vol. xxviii., No. 2) Sir James Frazer tells how, on Christmas Day, 1916, a solemn act of anathema was pronounced against the Greek statesman, M. Venizelos. In this case the victim was represented by a bull's head, at which stones were thrown and curses uttered. Sir James Frazer produces many instances in which stones are flung as a form of cursing, as in the well-known case of Shimei and King David. The bull's head finds a parallel in the ritual of ancient Egypt, where, according to Herodotus, black oxen were sacrificed, and then the head of the victim was laden with curses. After this rite it was sold to Greeks, if any happened to be present; if not, it was flung into the river.

IN the September issue of *Man* Mr. A. C. Breton, describing the Tsimhian Crest Poles at Hazelton and Kishpiox, British Columbia, remarks that these interesting totemistic objects are now decaying, and are not likely to be replaced. The principal post at Kishpiox had the form of a flagstaff, 80 ft. high, painted with a long black stripe proceeding from a black head with white eyes, at the base of the staff, and this represented a snake. On a small enclosed platform in front of this were two carved wooden figures—one the "Grizzly Bear under the sea," the other a finback whale. A good specimen of a similar pole is preserved at the Pitt Rivers Museum, Oxford. Now that attention has been directed to the few remaining examples it may be hoped that the Government of British Columbia will arrange for the removal of these interesting objects to some place of safety.

PROF. ELLIOT SMITH has reprinted from vol. vii. of the Proceedings of the British Academy his lecture on "Primitive Man." He gives an interesting review of the problem as it stands at present, and makes some suggestions which deserve attention. Thus he lays emphasis on the proposition that "man's mental and moral attitude is, in a large measure, determined by those primitive instincts and customs which he shares with his simian ancestors, but also by the influence, conscious and unconscious, of the atmosphere of traditions amidst which he has grown up. At no stage of

his career has he acquired highly complex and specialised instincts which impelled him, without any prompting from other peoples, to build megalithic monuments or to invent the story of the deluge independently of other people who do the same arbitrary things, as modern speculations would have us believe." Again, Prof. Elliot Smith urges that "these facts seem to emphasise how confusing is this use of the word 'age.' They also reveal how devoid of foundation is the misnamed 'evolutionary' theory that claims all these phases of culture as so many natural stages through which every people has passed in virtue of the operation of the blind forces of an arbitrary and inevitable process of evolution."

THE altitudinal distribution of birds in Europe represents an almost unworked field. Hence we welcome a most interesting and suggestive paper by Mr. C. J. Alexander in *British Birds* for August. Mr. Alexander confines himself to "Notes on Zonal Distribution in the Mountains of Latium, Italy." He divides this area into five zones, ranging from the Mediterranean, which extends from the sea-level up to between 300 and 500 m., to the Alpine, represented by exposed mountain peaks from 2000 to 2150 m. The only bird which runs the whole gamut is the black redstart. The wren, Alpine pipit, chough, wheatear, and linnet are, save the black redstart, the only residents of the sub-Alpine zone. The montane zone he finds the best characterised ornithologically of the three woodland zones. The dipper and the grey wagtail scarcely range out of the sub-montane zone. As might be expected, there is a vertical migration of the several inhabitants of these zones in accordance with the seasons, as well as a horizontal migration during the spring and autumn of birds passing to and from their breeding quarters further westward.

MOLES in captivity are notoriously difficult to manage. But Miss Frances Pitt has been remarkably successful in this undertaking, which she describes in the *Scottish Naturalist* for September. The extraordinary voracity of this animal is well known, but yet it is probably not generally realised that it will eat more than its own weight of earthworms in twenty-four hours. One of Miss Pitt's captives, weighing no more than 4 oz., ate during one month 7½ lb. of worms. Finding it difficult to maintain a supply for her captives, she experimented with raw beef, mutton, fowls' heads, and the livers of rabbits, with varying success. Cheese always seemed to be acceptable. Placed in glass boxes, she was able to watch them at nest building and excavating. When burrowing, the earth dug by the hands was thrown out by the hind feet, which were also used in cleaning the fur and the hands. But this paper, which has not yet reached its completion, is too full of interesting matter to be briefly summarised; it must be read at length by all who are engaged in the study of animal behaviour.

IN his account of the Echinoderms other than Holothurians obtained by the British Antarctic (*Terra Nova*) Expedition, 1910, and recently published by the British Museum, Mr. Jeffrey Bell lays great stress on the extraordinary variety in the characters of most of the Echinoderms collected in the Antarctic regions, although the conditions of depth and temperature are practically uniform. So astounding are the variations of the starfish, *Cycethra verrucosa*, that "if a mystic wanted a type of human life he might well take this species." A whole plate is devoted to these variations, and another to the variations of the brittle-star, Ophiosteira. The most interesting forms described are perhaps the three new species of Astroporpa, Astroschema, and Astrotoma, and it is rather strange that neither these nor the new starfish, *Luidia scotti*, should have been accorded any illustration. The course followed by Mr. Bell runs counter to that now strongly advocated by many systematists, but there is something to be said for it all the same. We note that Mr. Bell refers to his three new brittle-stars as "Astrophiurids." His original term was "Astrophiuræ, or Cladophiuræ." His present term implies that they belong to the same family as Astrophiura, which, as he well knows, is a totally different thing.

IN *Naturen* for May and June Hr. Jan Petersen describes and illustrates a number of newly discovered figures of animals incised by Stone-age artists on rock-surfaces in southern Norway.

THE vexed question of the age of the Borrowdale volcanic rocks, which add so much to the picturesque scenery of Cumberland, rises again in a paper by Mr. J. F. N. Green on "The Age of the Chief Intrusions of the Lake District" (Proc. Geol. Assoc., vol. xxviii., p. 1, 1917). The Borrowdale lavas are placed in the Llanvirn series. The Carrick Fell complex is shown, on the evidence of pebbles in the Watch Hill beds, to be older than the Bala rocks, and, with the Eskdale granite, it is regarded as belonging to a late phase of the Borrowdale activity.

IN a short paper on "The Geology of the Fiji Islands" (Proc. Nat. Acad. Sci., vol. iii., p. 305, 1917), Mr. W. G. Foye, of Middlebury College, Vermont, indicates that the present coral-reefs of the Fijis depend for their form on Pleistocene and recent movements, and that the growth of atolls and barrier reefs in this region is due to local and not to widespread subsidence. The submergence is more recent than the return of the waters to the ocean after the Glacial epoch. The author's paper on the same subject in the *American Journal of Science* has already been noticed (NATURE, vol. xcix., p. 471).

PROF. J. W. GREGORY'S lecture on "The Flowing Wells of Western Queensland," delivered in Australia in 1914, has been printed in the Queensland *Geographical Journal*, vol. xxx., p. 1 (1916). The vital question of the duration of these wells and the progressive diminution in their output is seen to be unanswerable at present. The discussion on the resolutions which followed the lecture shows that the diminution in supply may be due to escape in the bore-holes and choking of the inlets, and that there is a tendency to regard with favour Prof. Gregory's view as to the plutonic nature of the water-bodies.

IN the issue of *Scientia* for August, Mr. W. B. Wright, of the Geological Survey of Ireland, furnishes a useful review of "The Interglacial Problem," in which, following and extending the views of Penck, he shows that interglacial deposits indicate a woodland phase, followed by a steppe phase. He urges that the latter points to the oncoming of a glacial epoch, but extends well back into interglacial time. The single interglacial episode recorded in many northern areas, such as North America, may be explained by the fact that the longer of the Alpine interglacial epochs alone had any marked effect on the larger and more stable ice-sheets.

A REPORT published by the Royal Cornwall Polytechnic Society gives meteorological tables for Falmouth Observatory for the year 1916 and lustrum tables for sea temperatures, 1911–15. Mean sea temperatures are also given for the period of thirty-six years for each month. The lowest mean is 47·1° F., in February, and the highest 59·7° F., in August, the mean for the several seasons ranging 12·6° F. during the year. Detailed values for the several elements are given in the meteorological tables, and comparisons are made with the averages for a long period of years. The new units of millibars for the barometer, millimetres for rainfall,

and metres per second for wind velocity are systematically used, but temperature values are given in Fahrenheit. Falmouth Observatory is one of the Meteorological Office weather stations, and the records are of a high standard.

Symons's Meteorological Magazine for September deals tentatively with the rainfall of August and the summer of 1917. It promises later to utilise more fully the ample details supplied by numerous observers. The south and south-east of England, which felt the full influence of a partial drought in the middle of last June, have since experienced rainstorms of considerable magnitude. In August large portions of the country had more than 6 in. of rain, the fall exceeding 10 in. over the elevated parts of Devon and Somerset. In the normally rainy portions of England and Wales the rains exceeded 20 in. during the month, and in parts of Ireland the measurements exceeded 10 in., in many places constituting an extreme record for the month over a long series of years. In Scotland the rainfall was generally less remarkable, but the mean atmospheric pressure for the month was the lowest recorded in August for at least fifty years. For England and Wales the August rainfall was 192 per cent. of the average, for Scotland 121 per cent., and for Ireland 192 per cent. During the wet August of 1912 the rainfall in England and Wales was 198 per cent. of the average, but in Scotland it was only 119 per cent., and in Ireland 129 per cent. For the three summer months, June to August, the rainfall was more than 40 per cent. above the average over the greater part of the south of Ireland, south-west Wales, and south-east of England. Portions of Middlesex, Surrey, Sussex, and Kent had an excess of more than 80 per cent. of rain, rising in patches to double the average. Less than the average rain fell in the north and west of Scotland, and as far south as Morecambe Bay. In the northern midlands of England the rainfall was only slightly above the average.

SCIENTIFIC PAPER 300 of the Bureau of Standards contains a summary of the results obtained by Mr. W. W. Coblentz in his researches on the emissivity of the tungsten filaments of incandescent electric lamps filled with nitrogen. Both straight and coiled filaments have been investigated, the latter being the more efficient owing to the diminution of the heat convection and conduction losses for them. The coils had an inside diameter and a pitch twice the diameter of the filament. The radiation from an element of surface within the coil was found to be 90 per cent. greater and relatively redder than that from an outside element. The difference between the two was found to be in agreement with that calculated on the assumption of multiple reflections within the coil. Neither the internal nor external radiation E can be expressed in terms of the wave-length λ, and the absolute temperature T by any formula of the Wien type, *i.e.* $E \propto \lambda^{-c_1} e^{-c_2/\lambda T}$, in which c_1 and c_2 are constants.

La Nature for September 1 contains an article on recent improvements in wireless telegraphy by M. H. Volta. Fifty lines of it have been censored by the French authorities, but enough of the article remains to show how well the importance of the subject is appreciated in France. After describing the principles on which the earlier detectors—the iron or nickel filings coherer, the electrolytic, the thermoelectric, and the magnetic detector operated—the author shows how these have been superseded by the electronic or "valve" detector, and describes several of the forms and circuits at present used. By coupling a number of these detectors in series a high degree of sensitiveness may be secured, but Pratt, of the University of California, has introduced a combined electronic and thermoelectric detector, by means of which he has detected signals from stations 10,000 kilometres away. The General Electric Co. of Schenectady has shown how electronic "valves" may be used as sources of wireless waves, and it is not too much to say that the "valve" has revolutionised wireless telegraphy. The problem of diminishing the disturbances which so seriously interfere with the use of these sensitive pieces of apparatus has to some extent been solved by dividing the antenna into sections separated by inductances and connected to earth by inductances which give the parasitic currents a frequency differing from that of the signalling current.

THE greater part of the roof of the Library of Congress, Washington, U.S.A., is covered with tinned sheet copper, all of which is from the same manufacturer, and was installed at the time of the completion of the building in 1893–94. This has undergone a curious corrosion process which presents some unusual features, and has been investigated by P. Merica and reported on in Technologic Paper No. 90 of the Bureau of Standards. The roof is situated in a district uncommonly free from smoke, and it is not near any power station or factory producing smoke, so that atmospheric conditions may be regarded as most unfavourable for corrosion. Nevertheless, the sheet has become badly pitted on the upper side, and the pits occur in general along the line of surface scratches. They are apparently unrelated to the service conditions and to the direction of the rolling of the sheet. When the copper became exposed, as in the present case, at the bottom of the scratches on the surface, it formed a galvanic couple with the alloy layer, electrolytic action set in, and the copper at these points was corroded, forming the pits described. This publication gives the results of a study of the structure of the tin coatings on copper, and it is shown that this coating consists of at least three layers, viz. a thin layer of Cu_3Sn immediately next the copper, then a layer of the constituent "H," containing about 60 per cent. by weight of tin, and finally a layer of the eutectic of tin with copper. These alloy layers are electronegative, both to the tin and the copper base.

THE seventh and concluding article of a series on the evolution of the chain-track tractor appears in the *Engineer* for September 21. In these articles, which are fully illustrated, will be found a connected narrative showing the steps by which workable machines were produced. No mention is made of any work done in Germany or Austria, since, so far as our contemporary is aware, these countries have played no part whatever in the actual evolution of vehicles of this type. Nor has France added materially to the development of the chain-track mechanism. The system appears to have been evolved gradually by a great many workers, who have carried on their investigations independently, though for the most part on similar lines. An exception is Mr. Diplock, who alone pointed to the necessity for having the roller chain flexible, and each foot of the chain track absolutely free to move in any direction and within certain limits with respect to the other feet immediately adjacent to it, if the best results as regards friction and freedom from wear-and-tear are to be looked for.

THE latest catalogue of second-hand books (No. 169) of Messrs. W. Heffer and Sons, Ltd., Cambridge, is mainly devoted to school books, but there are sections relating to works in botany, chemistry, geology, biology, mathematics, medicine, and education, which should make it useful to readers of NATURE. Copies of the catalogue are obtainable from the publishers upon written application.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A Copenhagen telegram announced an observation of Encke's comet by Dr. Max Wolf on September 14. At 13h. 51·3m., Königstuhl Mean Time, the position of the comet was R.A. 6° 24′, declination +13° 16′. The *Morning Post* of September 26 states that an observation made on September 21 proves the object to be a new comet, and not Encke's comet, as first supposed.

AN EMPIRICAL LAW OF PLANETARY DISTANCES.—An interesting empirical law connecting the distances of the planets from the sun is discussed by G. Armellini in the *Observatory* for September. The law is expressed by the simple formula $x_n = 1·53^n$, where 1·53 represents the distance of Mars from the sun, and n takes the values −2, −1, 0, 1 . . . for the planets Mercury, Venus, Earth, Mars . . . The numerical values given by the formula are compared with the true values, and with those given by Bode's law, in the appended table:—

	Formula	True distances	Bode
Mercury	$1·53^{-2} = 0·427$	0·387	0·4
Venus	$1·53^{-1} = 0·654$	0·723	0·7
Earth	$1·53^{0} = 1·00$	1·00	1·0
Mars	$1·53^{1} = 1·53$	1·52	1·6
Asteroids	$1·53^{2} = 2·34$	...	2·8
	$1·53^{3} = 3·58$	...	
Jupiter	$1·53^{4} = 5·48$	5·20	5·2
Saturn	$1·53^{5} = 8·38$	9·54	10·0
(Vacant place).			
Uranus	$1·53^{7} = 19·46$	19·2	19·6
Neptune	$1·53^{8} = 29·76$	30·1	38·8

It will be seen that the formula has a marked advantage over Bode's law in the representation of Neptune. Moreover, since the two distances given for the asteroids are comprised within the limits of the asteroidal zone, there is only one vacant place, whereas Bode's law, if written in the form $x_n = 0·4 + (0·3 \times 2^n)$, presumes the existence of an infinite number of small planets between Mercury and Venus. It is considered possible that the vacant place between Saturn and Uranus may be occupied by small planets which have not been detected on account of their great distances.

ECLIPSING VARIABLES.—Photographic light-curves of the eclipsing variables, TT Lyræ and Y Camelopardalis, obtained at Harvard, have been utilised in a discussion of the orbits of these stars by Martha B. Shapley (*Astrophysical Journal*, vol. xlvi., p. 56). The periods derived from the new observations are respectively 5·243708 days and 3·305568 days. In the case of TT Lyræ the observations give positive evidence of a shallow secondary minimum and of a variation of light due to the ellipsoidal form of the components. There is also an unusually large "reflection" effect, which is attributed to inter-radiation, and on this interpretation the hemisphere of the faint star which faces the bright component is eleven times as bright as the other. Since only a small part of the light of the bright star remains visible at principal minimum (the variation being 2½ magnitudes), a large proportion of the total loss of light at that time is due merely to rotation of the unequally illuminated faint companion. Y Camelopardalis has also a large range of variation, losing 78 per cent. of its light at principal eclipse. The two systems are closely similar in many respects, and are estimated to be more than 3000 light-years distant from the earth.

Similar observations and determinations of orbital elements have been made at the Laws Observatory in the case of the eclipsing variables Z Vulpeculæ, TV Cassiopeiæ, and *u* Herculis (Laws Observatory Bulletin, 26, 27, 28). The elements of the eclipsing systems TV, TW, TX Cassiopeiæ, and T Leonis Minoris have been investigated by R. J. McDiarmid (Dissertation, Princeton University). The brightness of TX Cassiopeiæ is estimated to be 1400 times that of the sun.

THE EGYPTIAN OIL FIELD.[1]

THE Egyptian oilfield occurs along the western coast of the southern end of the Gulf of Suez, and, being beside a great ocean highway, is in a most convenient position for an oilfield, and where mining operations should throw light on some interesting geological problems. Dr. Hume writes on this field with high authority and intimate knowledge; his information and conclusions are, however, often indefinite, and his report has that air of detachment from practical applications which has been responsible for much of the distrust of geology felt among mining engineers. The author is no doubt wise to avoid unnecessary trespass on the field of the engineer, and his report is on the region and not on the oilfield alone. It would, however, have been even more useful if it had included statistics of the oil yields and information as to the quality of the oil, and if the author had not declined to express any opinion on the future of the field.

His geology is also cautious. He states that the oil is mostly derived from a cavernous dolomitic limestone, which he regards, however, as merely a reservoir. He attributes the source of the oil to deeper beds of Globigerina marl. This suggestion may be due to the influence of Prof. Mrazec, who accompanied Dr. Hume on a visit to the field, has contributed the cross sections to the report, and is probably responsible for the suggested comparisons with the Rumanian oilfields. The Egyptian oilfield appears to have much more in common with that of Persia than with that of Rumania. In the fields beside both the Gulfs of Persia and Suez the chief oil horizon is a thick series of gypsum beds which Dr. Hume regards, doubtless correctly, as lagoon deposits; they overlie a Mid-Miocene (Helvetian) coral limestone, and lie below a limestone containing a fossil oyster, *Alectryonia virleti*, which is characteristic of the Upper Miocene (Tortonian). Dr. Hume refers this bed to an indefinite "Mio-Pliocene" horizon, which he places above the Lower Pliocene. The remarkable resemblance in the general succession of the Egyptian and Persian oilfields favours the correlation of the virleti beds with the Upper Miocene, and the origin of the oil from the gypsiferous deposits.

The Egyptian oilfield structurally consists of a band of sedimentary rocks which has sunk between the granitic masses of Sinai and south-eastern Egypt. It thus resembles the Alsatian oilfield which has been lowered between the Archean masses of the Vosges and the Black Forest. By this movement the beds have naturally been folded and faulted. But it is not clear from Dr. Hume's account whether, in the Egyptian field, the folding was the primary movement, or, as in the Alsatian field, was secondary to the faulting. He attaches most stress to folding, but he includes therein movements that would generally be regarded as faulting; for the upraising of a mass of old granite into overlying sediments, which are thereby disturbed and brecciated along the contact, he includes as folding.

The report is well illustrated by numerous photographs and an excellent map by Dr. Ball, and though the text leaves us wishing that the author out of the fullness of his knowledge had given more information on some branches of the subject, we are grateful for a valuable addition to both Egyptian and economic geology. J. W. G.

[1] Ministry of Finance, Egypt. Report on the Oilfields Region of Egypt. By W. F. Hume, Director of the Geological Survey of Egypt. Pp. viii+103+23 plates. (Cairo: Government Press, 1916.)

THE STATISTICS OF THE DAIRY.

Dr. Raymond Pearl is one of the younger generation of American biologists. He belongs to that school of naturalists who pursue, to begin with, the critical study of evolution, dealing not with its results alone but with its actual phenomena, who inquire into the essential facts and ways of working of selection, and who investigate accordingly all the problems, mathematical and other (especially those relating to "probability"), which are associated with variation and heredity. He belongs, that is to say, to the twin brotherhood of the experimentalists and statisticians, and like others of his school he has of late turned his investigations into very practical lines. A batch of Dr. Pearl's recent papers has come to hand, mostly on work done in connection with the Agricultural Experiment Station of the State of Maine. One—a very interesting one—is a general review of "The Selection Problem." Others deal with statistical and biometric methods—for instance with class-frequencies, with the gamma function, and with other matters connected with "curve-fitting." The rest of the batch are for the most part experimental studies, on egg-production or "inheritance of fecundity" in the common fowl, and on various problems of productiveness and of race-inheritance in cattle. Let us consider one only of these papers (or rather a part of one), which deals with "Animal Husbandry Investigations," and in particular with the "Study and Analysis of Milk Records."[1] This is a very practical subject indeed, and all the more so at present, when questions of efficiency in food production are of the highest and most obvious importance.

The essential problem before us is the comparison of two dairies, or two herds, with regard to milk production; how are we to say, or to discover, which herd is the better of the two? Simple as the case at first sight seems to be, it really involves a curious and puzzling statistical problem; for the yield of each individual cow not only depends on its own intrinsic "quality," but is very largely influenced by two distinct factors, namely by the animal's age and by the time which has elapsed since calving. The cow is at her best when about five to six years old; her yield of milk increases up to that age, and slowly falls away afterwards. Whether she be old or young, her yield is at a maximum shortly after calving, and month by month it gradually and slowly diminishes. We must find some means of *equating* our two sets of data for the two herds, when none of the individual data are directly comparable, for the cows in our two herds will differ, at haphazard, in age and in the period elapsed since parturition. We must, in other words, discover some system of "weighting" for these factors, or (what comes to the same thing) some way of adjusting the actual yield to a *standard condition* of age and period. It is obvious, then, that any such calculation must be preceded by a long and comprehensive experimental investigation. After this experimental basis is obtained (and for practical purposes Dr. Pearl has now sufficiently achieved it—unless, perchance, there turn out to be significant differences in the case of Jerseys or other special breeds), the rest is easy; but I have tried (with Dr. Pearl's approval) to simplify his own very lucid account still further, and to employ for this purpose a simple chart or diagram.

As the outcome of all his previous investigations, Dr. Pearl gives us a table of percentage efficiencies in dairy cattle, of which the following is an abbreviation or abstract. We shall not, by the way, carry our discussion beyond the period of ten or eleven months after calving, after which time (provided the cow does not calve again) the yield may still continue a long while, diminishing very slowly in quantity; we must also remember that, for cows ending their lactation in earlier months, the curve will drop somewhat abruptly to zero; and we must not forget that this is a quantitative study only, and that the quality or richness of the milk must be dealt with separately.

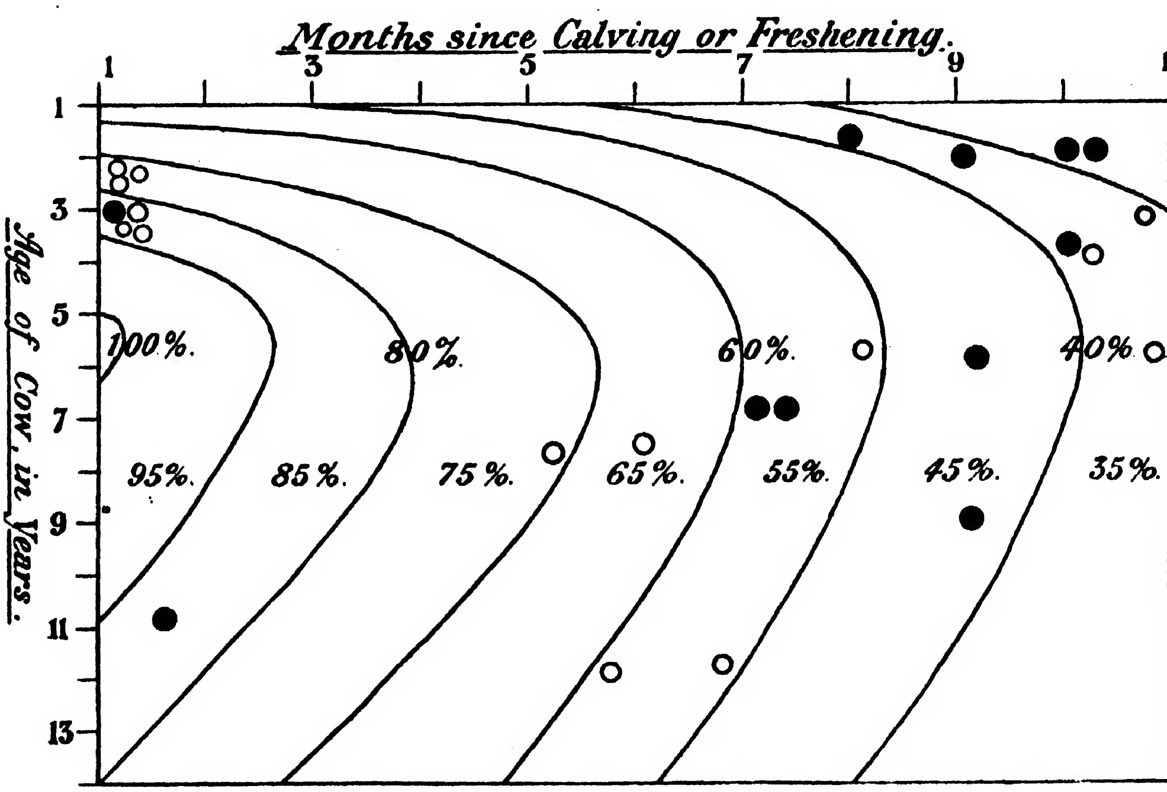

Fig. 1.—Percentage-efficiency chart of milk production. Two herds, A and B, are supposed to have been plotted on the blank chart ●, cows of Herd A; ○, cows of Herd B.

Table of Percentage Efficiencies.

Age of cow, in years	Stage of lactation, in months					
	1 Per cent.	3 Per cent.	5 Per cent.	7 Per cent.	9 Per cent.	11 Per c
1½	58	51	44	37	30	27
3½	93	81	69	56	44	38
5½	100	86	72	59	46	38
7½	99	85	71	57	44	37
9½	94	82	69	55	43	36
11½	88	76	65	53	41	35
13½	82	71	61	50	39	34

From this, or from the full table, we may now prepare our diagram, in which the several contour-lines denote percentages of the maximum or ideal efficiency, 90 per cent., 80 per cent., etc., and the spaces or zones between them represent, therefore, *average* percentage efficiencies of 95 per cent., 85 per cent., etc., as compared with the standard of maximum—this latter being what we should expect were the cow five to six

[1] Report of Progress on Animal Husbandry Investigations in 1915; Maine Agricultural Experiment Station, Orono, Maine. (Papers from the Biological Laboratory, No. 92.)

years old and in her first month of lactation. In order to make use of this chart, then, we proceed to make a mark upon it for each individual cow, each mark corresponding (vertically) to a particular age, and (horizontally) to a particular month of lactation; and this has been done in our figure for two distinct and separate herds, one of fourteen, the other of eleven cows. In short we note upon the chart the cow's age and period, and are then able to read off the corresponding "efficiency" which we are entitled to expect of her. It only remains for us to add up the number of cows (of each separate herd) in each zone or "efficiency class," and then to proceed as follows, by the simplest arithmetic:—

Comparison of Herds A and B.

Efficiency class Per cent.	Herd A No. of cows	Herd A Total efficiency Per cent.	Herd B No. of cows	Herd B Total efficiency Per cent.
85	2	170	3	255
75	—	0	4	300
65	—	0	1	65
55	2	110	3	165
45	2	90	—	0
35	3	105	3	105
25	2	50	—	0
	11	525	14	890

Average efficiency per cow, 47·7 p.c. ... ... 63·6 p.c.

Total yield of milk per day, 260 lb. ... ... 290 lb.

Average " " per cow, 23·6 " ... ... 20·7 "

Standard yield at maximum efficiency $\frac{100}{47.7} \times 23.6 = 49.4$ " $\frac{100}{63.6} \times 20.7 = 32.5$ "

The value which we obtain as our final arithmetical result, viz. 49·4 lb. and 32·5 lb. respectively, for our two herds, may be called the "standard of efficiency," or "standard yield at maximum efficiency," or (for short) the "specific standard" of the herd.

In practice we should have to take into account (as we have not here done) cows that have gone dry, though of an age and period when they should still have been milking; this would introduce a further, but very slight, complexity. Apart from this, and as our broad and simple result, we see (1) that Herd B was operating at a higher efficiency than Herd A, *i.e.* the cows in B were in the better state as regards age and period; but nevertheless (2) Herd A was actually yielding 23·6/20·7, or 14 per cent. more milk per cow; and (3) the most important thing, that Herd A was giving a yield which, when reduced to standard (as though every cow were five years old and newly calved), would be equivalent to 49·4/32·5, or no less than 52 per cent. more milk than Herd B under similar standard conditions. Herd A was one of the best herds of pure-bred Holstein-Frisian cattle in the State, while B was only a fair average or dairy herd.

It is obvious that we may use the same method (with the help of equally easy arithmetic) to determine the value or "efficiency," in comparison with the herd as a whole, of any individual cow. For instance, after we have determined the standard efficiency, or standard yield at maximum efficiency, of Herd A to be 49·4 lb. of milk daily, then a cow the age and period of which place it in the 55 per cent. zone should be yielding something between 50 per cent. and 60 per cent. of that amount, say from 25 lb. to 30 lb. of milk daily. She is not doing her duty by the rest of the herd, and may be weeded out accordingly, if her daily yield of milk be found to be below this quantity.

D'ARCY W. THOMPSON.

AGRICULTURE IN MADRAS.

FEW aspects of Indian administration have manifested more satisfactory advancements than that of agriculture. Since the date of reorganisation of the department into provincial sections (acting under effective Imperial control), since the date when the bulk of the officials under these became expert agriculturists, the improvement has been both substantial and far-reaching. The keynote, moreover, seems to have been the separation of agriculture from revenue. But one can imagine the old Bengal civilian turning in his grave with horror at the abolition of his "Revenue and Agricultural Department," the "et cetera" of former times. To-day the people of India can receive the agricultural official as a friend, free from suspicion of mercenary (revenue) alternatives. No better manifestation of this improved relationship could be given than the appearance of the Madras Agricultural Calendar.

A double page is devoted to each month, from April to March (the official year), and these twelve tables set forth the phases of the moon, the constellations of the stars, the feasts, fasts, festivals, the fairs, shows, exhibitions—all matters of more than ordinary interest to the Indian cultivator. Between the pages of monthly records are interspersed instructive, brief, but practical, chapters on various useful subjects, written by the director, the assistant director, the various deputy directors, and other officials of the department.

The purpose of the Agricultural Department is lucidly set forth; the importance of water to the farmer fully expounded; the merits of the specially selected and improved cotton-seed (here called Sircar cotton) explained and offered for sale; the properties of the Monsoon plough exemplified; the value of superphosphate as a manure for rice explained; then follow suggestive and instructive essays on agricultural engineering; on the conditions under which agricultural loans can be made by the Government; on special crops, such as ground-nuts, guinea-grass, indigo, senna, etc. Next there are given chapters on the improvement of pasture lands, on the Veterinary Department, and on the diseases and pests of crops. The Calendar then supplies particulars of the Agricultural College, the Research Institute, etc., and finally gives a complete enumeration of the departmental and other publications likely to be of value to the farmers.

We commend this excellent little publication (78 pages) as a model of public utility, the more so since it is offered for sale at the humble price of one anna (one penny), and is printed both in English and in the chief vernaculars of the province.

SCIENCE AND INDUSTRY IN SOUTH AFRICA.[1]

OUR Government, I am afraid, has not always fully realised in the past the powerful aid of science and scientific research in general and industrial development. It has been following too much the lead of Great Britain, and has been perhaps too much inclined to regard the scientific departments of the Government as not of primary importance, since they are not immediately productive in the commercial sense. The totally inadequate salaries paid to the *personnel* of Government scientific departments is perhaps an indication of the place which their work has occupied in the general plan of the nation. Only recently a protest was made

[1] From the Presidential Address delivered at the Stellenbosch Meeting of the South African Association for the Advancement of Science, on July 2, by Prof. John Orr.

in connection with an advertisement for a mycologist—who had to be a university graduate—at the princely remuneration of 180*l.* per annum. Science may be its own reward, but even the poor man of science must live.

But all this is going to be changed. Science has gained immensely in prestige since the war began. The consequences of the neglect of science and technical training have been brought home to such an extent that, terrible as that conflict is, there can be no question that it has served to vitalise, as nothing else could have done, the British nation; and, perhaps, the greatest lesson of the war has been the realisation of the necessity for greater scientific methods in relation to industry. The appeals of scientific and technical men, which have so often been disregarded by apathetic, self-satisfied, and conservative manufacturers, pursuing rule-of-thumb and obsolete methods, and, by their inaction, allowing so often the fruits of British brains to be exploited in Germany, would now appear to be falling on receptive ears, and we welcome the prospect of a new era for science and scientific methods. We must realise that the whole fabric of industry is based on science, and Governments are now recognising it as their duty to embark on a more enlightened policy by promoting scientific research on a national scale. It is for associations such as this to see that the new ideals are maintained.

The Union Government established, about a year ago, an Industrial Advisory Board of business men, to which a technical member was at a later date added. But as a result of the representations of the Central Committee of the Scientific and Technical Societies of South Africa, on which this association was fully represented, the Government agreed in March of this year to the appointment of a Scientific and Technical Research Committee to assist the Industries Section of the Department of Mines and Industries in providing for industrial research, co-ordinating, so far as possible, all industrial investigation and research in South Africa, and collecting and disseminating all data obtained; in co-operating with other Government departments and with similar departments in the United Kingdom and Dominions to obtain information already available, so as to avoid overlapping, to take advantage of facilities for research not available in this country, and to acquire and utilise in the arts and manufactures knowledge already existent in countries which are more highly developed industrially than South Africa; in carrying out an economic survey of the natural resources of South Africa, and in furnishing advice in regard to the best methods of utilising such resources; in furnishing advice with regard to the best method of attacking industrial problems; in inducing industrial improvements and facilitating and encouraging manufactures in suitable localities; in co-ordinating various industries to obtain the best combined results and exchanging between user and manufacturer manufacturing improvements and operating experience; and generally in advancing the work of the department on the scientific and technical side.

The action of the Government in advertising for a technical adviser, at a salary commensurate with the importance of the position, is one which must be cordially welcomed as an indication that it realises the importance of the present movement.

The Scientific and Technical Committee held its first meeting at Capetown in April of this year. The published list of fifty-two subjects on which it is proposed to obtain the earliest and fullest existing information from the most competent authorities available gives some idea of the programme which the committee has outlined apart from an indication of the latent potentialities of the Union as a manufacturing country. Time forbids detailed reference, but it will be observed that the investigation of raw materials and products from the agricultural and pastoral industries, together with various valuable by-products, hitherto neglected, bulks largely amongst the subjects.

It is not my intention to attempt to deal fully with the many problems with which South Africa teems, even those which bear on the development of our great country. Unfortunately, many of our problems have, for some reason or other, been converted into political questions, and at this non-political gathering anything savouring of politics must be rigidly excluded. Mr. Merriman has said that there is too much politics in this country; those who belong to no political party will, I think, agree with him. Almost every man and woman in South Africa is a politician, and we send forty-one lawyers to Parliament. One of our members who combines the pastime of ardent sociology with the professional pursuit of science advocates government by function, according to which the only reason for sending a man or woman to Parliament would be special fitness as an expert on some particular subject, or as a representative of some particular interest. Political cleavages are not doing this country any good. Let the advice of the Administrator of the Orange Free State be taken in the spirit in which it has been offered. "Last year," he is reported to have said, "the Union imported leather goods to an amount almost equal to that which farmers got for their wool. Whilst they were quarrelling about small matters, they were really forgetting the things that mattered. Each year grain to the value of 1,500,000*l.* was imported, although the South African climate was excellently suited for grain production. When it was dry they prayed for rain, but when the rain came, millions of tons of water were allowed to run to waste to the sea. . . . Europeans were only comparatively few in South Africa. Why, then, should they continue quarrelling instead of developing their country?"

The whole land abounds with examples of neglected opportunities. The Government has repeatedly made the statement that it cannot start industries; it can only give advice. And when we consider for a moment what has been done through its Agricultural and Lands Departments, unbiased observers must admit that advice has been showered upon the farmer in such profusion that it has come to be a source of irritation to those engaged in other industries, who accuse the agricultural interests of receiving undue preference. Frankly, we must admit that the farmer in many instances has not made the most of his opportunities. The recently issued reports of the Dominions Commission direct attention to the way in which Canada and Australia have been developed into great producing and exporting countries—it dwells on the wonderful external trade expansion of Canada, which increased 190 per cent. between the years 1900 and 1913—and emphasises the need for greater population, which, of course, means throwing open the land to the newcomer. As the Member for Stellenbosch has somewhat caustically said, we have "stoep-sitters at one end and poor whites at the other, and that state of affairs is not in the interests of the country. . . . Here the farmer waited for an Act of Parliament, and then often kicked at it." No one can object to the Government assisting in every possible way those who are honestly endeavouring to increase the productiveness of the country, and even to assist financially the victims of misfortune, but the manifestation of a spirit of greater self-reliance and progressiveness on the part of many would be greatly welcome by those who frequently complain that there is too much pandering to the agricultural interests. Unwillingness on the part of South Africans, by nativity and adoption, to meet the situation and exert their utmost endeavours in well-directed channels can only lead to the surrendering of their

opportunities to those more amply qualified by energy and initiative.

While the war has had the effect of stimulating, and in some cases initiating, production, it has also served to direct attention to products, hitherto neglected, which could be used as substitutes. But think how little has been done to manufacture the valuable products from maize—alcohol, starch, glucose, dextrine, glycerine, corn oil, etc., apart from the valuable feeding stuffs and other by-products obtained from these industries. At the last annual meeting of the S.A. Maize Growers' Association the president complained that practically nothing had been done to develop maize products in this country, and urged the appointment of a whole-time officer of the Agricultural Department to devote his energies to the maize-growing industry and its many products. A new future is opened up for the maize-grower by the possibility of the extended use of alcohol for power purposes. An investigation carried out two years ago demonstrated the practicability of alcohol as a motor fuel, so that now it is entirely a matter of commercial manufacture. In America the greater part of the industrial alcohol produced is made from maize. A factory, costing more than 50,000*l*., is in course of completion at Durban to produce alcohol from molasses, a by-product in sugar manufacture, but, as that is limited in amount, recourse must be had at no distant date to maize or other cereals, potatoes, etc. The agrimotor, of which hundreds are now at work day and night in Great Britain and France, is a product of the war, and with cheap alcohol motor fuel, derived from maize which he himself grows, to drive his mechanical cultivators, who shall say that the lot of the farmer of the future will not be a happy one? It will be seen that the subject of maize—its products and by-products—is receiving the attention of the Scientific and Technical Committee.

We also want a vigorous afforestation policy. Timber is used as a material in practically every industry, and its increasing use has for some years caused no little anxiety as to the world's supply; certain varieties are even now practically unobtainable. Attention is therefore being frequently directed to the value of afforestation as a State asset. But afforestation is of national importance, apart from the value of the timber produced. It has served for some years as a means of alleviating the poor white problem. It is a potent agent in the conservation of water, which is of all the more importance in a country like South Africa, so subject to periods of drought, and where soil erosion is becoming a national problem. All over the country we can see large areas absolutely ruined by a network of huge dongas, developed from small sluits, which originated probably in a cattle track. The Railway Department has been blamed, so have the Government road contractors, the Irrigation Department has been accused of negligence, while the older inhabitants blame the Government and say that soil erosion is entirely due to the denudation of trees and vegetation without a policy of replacement. The Minister of Lands blames the farmers! He has said that the first step towards a remedy is "to rouse public opinion and get the agriculturist interested in the matter." The remedies are said to include filling up the small sluits when they begin to form; increased afforestation and grass planting, which assist in conserving the rainfall instead of allowing it to carry millions of tons of valuable soil to the sea; and, of course, dam building and irrigation, which are claimed to herald the agricultural salvation of South Africa. The Government has repeatedly stated that it is alive to the importance of afforestation, and the Union can scarcely be charged with negligence, since 6300 acres were afforested in 1914, and although the acreage fell for obvious reasons to 3900 in 1915, and was slightly under 2400 in 1916, to-day the total area of forest reserves under the Forestry Department is more than 1,000,000 morgen. The State cannot be expected to do everything. Surely the farmer, who, in the majority of cases, is the landowner, realises that it is in his own interests, from the water conservation and the other points of view, to prosecute a vigorous scheme of afforestation, and, much as the State might assist in fighting soil erosion, individual effort must be strenuously exerted, if the problem is going to be solved.

These are subjects which, I am glad to say, are receiving the attention of the Scientific and Technical Committee.

The first work of this committee has been to arrange for a survey of the raw materials of the country, so as to ascertain what is available for active industrial exploitation. The Government is paving the way by investigation and research to show the world what the prospects of industry are, but the Minister of Mines and Industries has said that "the Government can only see that general conditions as regards tariff and legislation are reasonable and representative."

It is claimed that a country which imports annually thirty-eight million pounds' worth of merchandise must have great manufacturing possibilities. But manufacturing industries have languished in South Africa, and industrial failures have been many, due to a variety of causes. As one writer plaintively remarks, there has been "the usual dissipation of energies; the usual record of a few successes and many failures; and the usual discouragement, which seems the natural inheritance of the few people who try to bring South Africa to a realisation of her unique opportunities."

No industry can be welcomed as a permanent industry which does not utilise the raw products of the country. In this connection the absence of a "primary" iron and steel industry is most keenly felt. All manufacturers using metal are dependent upon the imported article, and although machinery is now being manufactured in South Africa, especially on the Rand, to an extent hitherto considered impossible, this has largely been due to the protection offered by the war, and must necessarily be transient. The importance of the establishment of an iron and steel industry in South Africa transcends that of every other industry; South Africa can never hope to become a machinery manufacturing country without it. We have the raw materials in coal and ore, but markets will have to be created to keep such an industry going continuously, as it must of necessity do. The Government can help by assisting in the initial stages, and it is to be feared that without some direct special assistance the prospects are remote. But it can also help indirectly through the railways. A guarantee of Government contracts, at any rate in the initial stages, should surely induce a flow of capital for such an important national industry. A glance at the imports for 1916 shows that, during that year, iron and steel to the value of nearly one and a quarter millions sterling, and machinery to the value of two and one-eighth millions sterling, were imported into the Union.

How colossal an iron and steel industry may become is shown by the fact that the output of the United States Steel Corporation reached in 1916 the huge total of nearly fifteen and a half million tons.

A successful experimental plant, constituting the first electric furnace in South Africa, was erected by the Chamber of Mines during the past year for making steel castings (shoes and dies) from scrap metal, and the manufacture of bar iron, etc., from scrap metal has been carried on for some years in the Transvaal. Such industries have been referred to as "bastard" industries; primary industries utilising the raw materials

are essential. A start was made in June in electro-chemical industries, when a factory for the manufacture of carbide was inaugurated on the Rand; but electro-chemical industries in other parts of the world rely mainly upon cheap electricity derived from water power, and it is of the utmost importance in the industrial development of this country that the Government should spare no expense in having the water-power resources of South Africa immediately investigated.

The great mistake in South Africa has been to look too much to the mines. Just as the discovery of the diamond mines saved the Cape Colony from dire financial distress, so we have the President of the Transvaal Chamber of Mines saying, at the last annual meeting of that body, that "the prosperity, and, indeed, the whole fabric, of the Union are largely based on the mining industry." But the mineral wealth of the Transvaal will not last for ever—the gold mines are a diminishing asset. Transvaal dividends amounted in 1916 to more than nine million pounds, but the Rand cannot go on indefinitely contributing more than 50 per cent. of the total revenue of the Union. We have examples from history to show that, where enlightened action has prevailed, the revenues derived from mineral wealth, instead of being utilised to lighten the burdens of the general taxpayer, have, to a liberal extent, been devoted to the general development of the country, and the establishment of industries to take the place of the worked-out mines, including of necessity ample provision for education and technical training and research.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A CHAIR of tuberculosis was instituted by the Edinburgh University Court on Monday, September 24, and Sir Robert Philip was appointed as the first professor of the subject.

ON Wednesday, October 17, at 5.30 p.m., Prof. J. A. Fleming will deliver at University College (University of London) a public lecture on "The Work of a Telephone Exchange." The lecture is open to the public without fee or ticket.

THE inaugural address of the new session of the School of Pharmacy of the Pharmaceutical Society of Great Britain will be delivered by Lt.-Col. E. F. Harrison on Wednesday, October 3, on which day the Hanbury gold medal will be presented to Prof. H. G. Greenish.

THE annual meeting of the Library Association will be held at Caxton Hall, Westminster, on October 3 to 5. The subjects to be discussed on the opening day are "The Relation of Libraries to Education" and "Work with Children," and the speakers will include Dr. Addison and Lord Bryce. On the other days "Commercial Libraries," "Technical Libraries," "Municipal Reference Libraries," and "The Education and Training of Librarians" will be discussed.

IT is reported in *Science* that provision has been made by the Texas Legislature for establishing a third agricultural college, to be known as the North-East Texas Agricultural College. A grant of 50,000*l.* has been made for its establishment and maintenance. The board of directors of the State Agricultural and Mechanical College is given control over the institution. State grants have also been made for the station and sub-stations amounting to 45,000*l.* for the year beginning September 1, and 36,300*l.* for the following year.

A SERIES of popular lectures on "The Countries of the Empire and their Resources," illustrated by the collections of the Imperial Institute, is being delivered by Miss Edith A. Browne, on Wednesdays in September, October, November, and December, at the Imperial Institute at 3 o'clock, commencing yesterday. Admission to the series of lectures is free by ticket, for which application should be made to the director of the Imperial Institute, South Kensington, S.W.7. A special course of lectures of the same character has again been arranged this autumn for public schools in and near London, in connection with the teaching of the commercial geography of the Empire.

SEVERAL large bequests and gifts for higher education in the United States have been announced this year in *Science*. Among these may be mentioned the addition of 100,000*l.* to the permanent endowment fund of Washburn College, Topeka, Kansas, 40,000*l.* of which was contributed by the citizens of Topeka, and 40,000*l.* from outside contributors. Bequests of 40,000*l.* have been received by Princeton University and by the University of California, in the latter case for the maintenance of professorships in law. Gifts of 30,000*l.* have been made to Muskingum College, New Concord, Ohio, to Columbia University, and to the University of Michigan. The most recently announced bequest, one of 20,000*l.* to Middlebury College, by Dr. H. F. Walker, is to provide full salary for a professor on Sabbatical leave, any balance to be used as an emergency fund.

WITH two minor alterations, parts i.–iii. and v. of the Regulations for Technical Schools in England and Wales (Cd. 7996) will continue in force for the school year 1917–18. The Board of Education withdrew part iv. of the Regulations in August, 1916. The alterations referred to came into force on August 1 last, and provide that institutions giving instruction in preparation for a trade for students formerly in attendance at special schools will in future be aided under the new regulations for such institutions, and will not receive grants under the regulations for technical schools. The second alteration concerns a few schools of the junior technical school or nautical school type, which, owing to the exigencies of war, have been unable to conform to their appropriate regulations; but the Board of Education proposes for the present to continue to recognise these schools.

IT is announced in the *Times* that Lord Lovat, Mr. Otto Beit, and Mr. Rudyard Kipling have accepted the positions of trustees under the will of the late Mr. Cecil Rhodes in succession to Lord Rosebery and Sir Lewis Mitchell, who resigned recently, and of the late Earl Grey, who had resigned shortly before his death. The trustees have decided to allot the four new scholarships created in substitution for the scholarships formerly held by Germans to the provinces of Alberta and Saskatchewan, to the Transvaal, to the Orange Free State, and alternately to the towns of Kimberley and Port Elizabeth in the Cape Province. As Alberta and Saskatchewan have hitherto had one scholarship between them, the effect of this decision will be that each of these provinces will now have a scholarship. The trustees have decided not to make any appointments to any scholarships this year, either in the United States or in any part of the British Empire, although the qualifying examinations in the United States will be held as already arranged. This decision is based upon the fact that as all candidates must be men of military age it would not be in accordance with the spirit of the testator's design if young men who first responded to the call of patriotism were to be penalised for having done so. Any candidate who is eligible this year will be equally qualified for election next year.

We learn from the *Times* that the members appointed in India to the Calcutta University Commission are Sir Ashutosh Mukharji, Vice-Chancellor of the Calcutta University; Mr. W. W. Hornell, Director of Public Instruction, Bengal; and Dr. Zia-ud-din-Ahmed, of the Mohammedan Anglo-Oriental College, Aligarh. The chairman of the commission will be Dr. Michael E. Sadler, who will be associated with three other members appointed in the United Kingdom, viz. Mr. P. J. Hartog, Prof. Ramsay Muir, and Prof. J. W. Gregory. The general terms of reference to the commission are to inquire into the working of the present organisation of the Calcutta University and its affiliated colleges, the standards, the examinations, and the distribution of teachers; to consider at what places and in what manner provision should be made in Bengal for teaching and research for persons above the secondary-school age; to examine the suitability of the present situation and constitution of the University and make such suggestions as may be necessary for their modification; to make recommendations as to the qualifications to be demanded of students on their admission to the University, as to the value to be attached outside the University to the degrees conferred by it, and as to the relations which should exist between the University and its colleges or departments and between the University and the Government; and to recommend any change of constitution, of administration, and of educational policy which may appear desirable.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, September 10.—M. Paul Appell in the chair.—H. Le **Chatelier** and E. L. **Dupuy**: The heterogeneity of steels. A modification of Stead's etching reagent is suggested, with full details of use. The macroscopic structure is well brought out by this reagent.—P. **Termier**: The posthumous notes of Albert Cochain.—H. **Duport**: Orthogonal systems.—P. **Humbert**: The piriform surface.—M. **Fréchet**: The notion of neighbourhood in abstract ensembles.—L. **Launoy**: The delicacy of the general method of extracting alkaloids from water. Working on 200 c.c. of solution, making alkaline with sodium carbonate, and with chloroform as the extracting solvent, 0·0001 gram of alkaloid (7 in 2,000,000) can be detected. With aconitine one-half of this proportion has been detected.—M. **Travers**: A new volumetric method for the estimation of molybdenum and vanadium in steels. The molybdic acid is reduced with titanous chloride, the excess being determined by means of a ferric salt in the usual way. The same reagent is applied to the estimation of vanadium.—L. **Gentil** and L. **Joleaud**: The existence of transported strata in the region of Bizerte (Tunis).—M. **Baudouin**: The wisdom tooth, which varies with the nature of the food, is not tending to disappear.—P. **Wintrebert**: The automatism of the first movements of the body in *Scyllium canicula.*—H. J. **Hamburger** and D. J. de **Waard**: The influence of radio-active substances on the permeability of the kidneys to glycose. The retention of some glycose in the kidney has been found to depend on the presence of small proportions of potassium salts. In the absence of a salt of potassium, under the conditions of the experiment, no glycose is retained by the kidney. As potassium is the only radio-active element normally present in the body fluids, other radio-active substances were tried in the place of the potassium. It was found that uranium nitrate, radium bromide, and mesothorium could replace the potassium, if the strengths of the solutions were correctly adjusted.—F. **d'Herelle**: An invisible microbism antagonistic to the dysenteric bacilli.—A. The use of iodide of starch in the treatment of infected wounds. In the treatment of infected wounds the problem is to find a substance which, sufficiently stable and active, must not be immediately destroyed by the tissues, and of which the action ought to persist for several hours, or even days. Iodide of starch appears to meet all these requirements, and in the strengths suggested is not an irritant.—J. **Danysz**: The origin of the specific affinities between pathogenic microbial products and the animal organism.

BOOKS RECEIVED.

Gravitation: Discovery of its Cause and Mechanism. By H. Jamyn Brooks. Pp. 48. (Bristol: J. W. Arrowsmith, Ltd.) 1*s*. net.

Allen's Commercial Organic Analysis. Fourth edition. Vol. ix. Edited by W. A. Davis. Pp. xviii+836. (London: J. and A. Churchill.) 30*s*. net.

Carnegie Institution. Researches of the Department of Terrestrial Magnetism. Vol. iii. Ocean Magnetic Observations, 1905–16, and Reports on Special Researches. By L. A. Bauer and others. Pp. vii+445. (Washington: Carnegie Institution.)

A German-English Dictionary for Chemists. By Dr. A. M. Patterson. Pp. xvi+316. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 9*s*. 6*d*. net.

DIARY OF SOCIETIES.

MONDAY, October 1.

Society of Engineers, at 5.30.—Sewage and its Precipitation; Further Experiments: R. Brown.

WEDNESDAY, October 3.

Entomological Society, at 8.—Further Notes on Recapitulatory Attitudes in Lepidoptera: Dr. T. A. Chapman.

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THURSDAY, OCTOBER 4, 1917.

THE NEW EDUCATION BILL.

IF there has been any [illegible] arising out of all the dreadful evil of the present colossal struggle, it may surely be found in the awakened interest which all classes of the English nation are taking in the question of education.

The events of the war have clearly demonstrated the advantage which accrues to a trained and well-instructed people not merely in the hideous business of war, but also from the point of view of industry and commerce, concerning which it is now freely admitted that our chief competitor, Germany, was already bidding fair to become our most successful rival (in the applications of chemical science she had already surpassed us), even in industries in which we at one time thought we could never be equalled, still less surpassed. So penetrating was the conviction that, by a happy inspiration, it led the Prime Minister to call for the services of a man who, by training, education, experience, and a proved sympathy with education in its widest aspects and its most pervasive forms, would bring to the office of President of the Board of Education a new vision and the enthusiasm which would rouse Parliament and the nation to a due sense of their responsibilities for the effective education of all classes of the people. So we have now as the incumbent of this high and responsible office, not a politician, not a mere seeker after the spoils of office, or one who regards the position as a stepping-stone to more considerable posts, but the Vice-Chancellor of the University of Sheffield, Mr. H. A. L. Fisher. So great is the impression which has already been made in the few months since he entered upon his new duties, as a result of the zeal and intelligence with which he has gripped the problems awaiting solution, that the conviction is growing that such an office ought never again to be the sport of party politics, but should be regarded as one which can be adequately filled and have its full effect only when placed in the hands of a trained mind, experienced in the problems of education and full of sympathy with its varied expression.

Already Mr. Fisher, on the introduction of the Education Estimates during last session, has made clear the importance of education and of the necessity that the teacher shall not only enjoy a better status, but also be more liberally remunerated, and he has induced Parliament to grant him a larger subvention for this purpose than has ever been known in the history of the Board of Education. He has, moreover, signified his intention to ask Parliament to assent to a scheme of pensions for secondary- and technical-school teachers. On August 13, in introducing a measure into the House of Commons to make further provision with respect to education in England and Wales, he made a notable speech in which he outlined his proposals, surveying the entire field of education up to that of the university. Realising the necessity for recruiting the elementary schools with a race of healthy children, he has put forth proposals enabling local authorities to establish nursery schools for children from two to five years of age in which the main regard shall be the health, the nourishment, and the physical welfare of the child. It may be urged with some force that the provision of such schools should be obligatory on the local authorities wherever the circumstances demand it.

Having regard to the enormous national expenditure upon elementary education, and the necessity for conserving its full fruit, the Bill proposes to raise the compulsory full-time school age, without any remissions, to fourteen, and in order to prevent the waste of educational opportunity that now ensues on leaving the elementary school, to provide for further continued education, within the normal working hours, extending to at least eight hours per week for forty weeks in each year—in all, a period of 320 hours—embracing a course of instruction general and special, including physical training, and having regard to their future as parents and citizens as well as to their chosen vocation, for all young people from fourteen years until the age of eighteen is reached. This means the abolition of half-time for children under fourteen years of age, which prevails mainly (it exists scarcely anywhere else) in the textile towns of East Lancashire and the West Riding of Yorkshire. No measure is more fraught with potential good than these comprising the extension of the full-time school age until fourteen and the provision of the means of continued education of adolescents until the age of eighteen. The acceptance of this policy will simply revolutionise English education and raise up a race of young people ready for higher forms of instruction (provision is made for extending the sphere of the elementary school for children up to sixteen years of age) in relation to the wiser and more fruitful use of leisure, the possibility of a humaner life, and the claims of science in respect of all human activities, social and economic.

To give effect to these purposes will entail a vast expenditure in the way of suitable buildings, special equipment, and the provision of specially trained teachers, but the results will more than

justify it. The claims of industry, narrowly viewed, must give way to the supreme claim that every child born to the nation is entitled to the fullest opportunities of development of which his natural powers are capable. There will be a strong opposition in certain industrial areas to these measures, but it is to be hoped that Mr. Fisher will receive the fullest possible support from all who seek the lasting well-being of the nation.

Among other proposals in the Bill is one providing for the establishment of provincial associations under the direct initiative and control of the Board of Education. Whilst it is very desirable that such associations should be formed, having regard to the common interests of areas larger in extent than those of individual education authorities, it should surely be regarded as more consonant with the free spirit of English institutions to have encouraged the voluntary alliance of neighbouring authorities rather than the erection of a bureaucratic organisation centred in the Board of Education in London. It is to be hoped that before proceeding to a second reading this and other sections of the Bill which tend to strengthen the central body at the expense of the local authorities will receive serious consideration. Mr. Fisher has shown commendable enterprise and wisdom in his provincial campaign. He has come face to face with various interests; he has been well received and has created a favourable impression, whilst there has been no lack of determined and well-informed criticism of some important sections of his measure. Doubtless he will have profited much by his intimate contact with men and women of all ranks of life, educational and industrial, and the cause of education will have unquestionably gained much thereby.

HEALTH AND THE STATE.

Health and the State. By Dr. W. A. Brend. Pp. xi+354. (London: Constable and Co., Ltd., 1917.) Price 10*s.* 6*d.* net.

THE main object of this book is to establish the case for putting our public health affairs in the hands of those who have real knowledge of the subject," and "to demonstrate the need for complete re-organisation of the public health services." It is not necessary to read the whole of the eleven chapters which compose the volume to be fairly convinced that some re-organisation is indeed needed. Perhaps the chapter entitled "The Complexity of Public Health Administration" is sufficient by itself to achieve the author's aim.

Dr. Brend maintains that while there exists a very large mass of scientific knowledge at our disposal, the channels by which it reaches those who might be expected to benefit thereby are imperfect and obstructed. No fewer than eleven Government offices, five central authorities, and six local authorities are concerned to a greater or less extent in public health administration. Knowledge that has run the gauntlet of the Government offices and then weathered the storm of vested interests in the country at large is finally turned into law by a House in which it receives little or no expert scientific criticism. The seventh chapter—more than one-fifth of the book—is devoted to the Insurance Act, and is a remarkable exposition of the discrepancy that exists between knowledge and its application. The proposals and promises of 1911 are compared with the working of the Act to-day; the waste of opportunity for collecting valuable information, and the failure of the Act to apply the best medical treatment to the sick poor who are in need of it, are discussed at length.

Yet withal, the general impression left by the book is that though it is a careful study of present administration and a vigorous piece of destructive criticism, nevertheless the reconstructive proposals outlined are by no means necessarily sound. The author frequently postulates that environment lies at the root of nearly all the ills that flesh is heir to. He maintains that the number of unfit in a State depends more upon environment than upon any other factor, and that the main cause of the continuance of tuberculosis is a bad environment. "Defectiveness in school children, as most diseases elsewhere, is mainly a matter of environment." "Take a patch of, say, fifty acres from the most crowded and worst built district . . . set it down precisely as it is among the pines of Surrey . . . the probability is that the improvement in the health of the inhabitants would be enormous. There are, in fact, patches of bad housing in many country towns and villages presenting the worst features of slums, whose inhabitants, nevertheless, exhibit a high degree of healthiness."

The chief factor at work in bad environment (*i.e.* overcrowding of cities) is, in Dr. Brend's view, an atmosphere polluted by dust and smoke. That polluted air may be harmful, as is polluted water, is not questioned, but the argument contained in the passage cited, that bad housing and slum conditions are in themselves comparatively unimportant, does not appear valid. It is a matter of experience that so long as communities are small and scattered human beings can live under the most primitive conditions without suffering unduly, but even picked individuals when aggregated in large numbers suffer heavily from preventable disease unless the most strict precautions are taken. It is not recorded that the armies of the Napoleonic wars were particularly subjected to dusty, smoke-polluted atmosphere, yet their sickness rate was terribly high. We question whether the fifty crowded acres in Surrey would necessarily prove to be particularly healthy, although, of course, it is not proposed

to deny that the addition of pure air to already existing sanitary services is most desirable.

Dr. Brend advocates as a remedy the expansion or rarefaction of our large towns and the segregation of our factories (a substantial piece of work for the proposed Ministry of Health!). Perhaps in practice the difficulties of removing smoke from existing towns is less than that of removing our populations to better sites. We have sewage systems in all our large towns, and the problem of removing waste products of combustion may be no greater than that of getting rid of the waste products of the body or of the wash-tub.

The demand for a Ministry of Health, the permanent staff of which "must consist almost exclusively of medical and scientific men," has much to recommend it, but we are rendered somewhat dubious of the practical results of their lucubrations when we find the author remarking of vaccination: "It is open to argument whether this precaution is still essential purely as a prophylactic, though *it is of course important during an epidemic among persons brought in contact with the disease.*" We wonder whether Dr. Brend has considered the practical steps requisite to vaccinate persons brought in contact with the disease when, for instance, a tramp suffering from modified small-pox has spread the disease in perhaps half a dozen different towns. Nor are we clear as to the author's reasons for considering that the diagnosis of this disease has improved whilst opportunities of observing it have become enormously lessened.

As a whole the volume is well worthy of study. A wide range of subjects affecting public health is discussed—from the sale of abortefacients to the public health duties of the Treasury.

OPTICAL THEORIES.

Optical Theories, Based on Lectures delivered before the Calcutta University. By Dr. D. N. Mallik. Pp. 181. (Cambridge: At the University Press, 1917.) Price 7*s.* 6*d.* net.

THE subject of physical optics has undergone a strange vicissitude. Not long ago it ranked as one of the great divisions of mathematical science; now it has become almost wholly absorbed by a sister science. The phenomena of optics, by their variety and ever-increasing practical importance, attract and deserve specialised study; but the underlying theory can no longer be studied apart from electricity, and the long succession of theories of the æther in the nineteenth century form a closed chapter in the history of science. There seems little likelihood that the chapter will be reopened. In these circumstances the best approach to the subject may be a matter of doubt, depending a great deal on the temperament of the student. Those who are historically minded will urge that the present position is best apprehended by following the steps which have led to it; others will consider that adherence to the traditional mode of approach tends to root in the mind an obsolete mode of thought, and it is better not to trifle with the freedom which is now offered. Dr. Mallik's book offers a compromise which should be acceptable to both sides. A survey of the more essential properties and differences of the mechanical æthers that were once proposed, subordinated to the purpose of illustrating the difficulties which the electromagnetic theory strides over so easily that they pass almost unnoticed; afterwards, an account of the modern theory and results, contrasted where necessary with the mechanical æthers—these seem to bring out the essential aspects of our present knowledge, without undue neglect of the lessons of the past.

Dr. Mallik divides his subject into four principal chapters: early theories, elastic solid theory, electromagnetic theory, and electron theory. The separation of the two last has some disadvantages. So far as it relates to free æther, the electromagnetic theory is independent of electrons; but in the early extensions to dielectric media the object presumably was to evade, rather than to theorise on, the relations of matter to æther. To make a full discussion of the mechanical implications of this approximate treatment seems unnecessary at the present day; the undeveloped notions of permeability and specific inductive capacity scarcely need to be taken so seriously. An excellent summary of the whole argument is given in the concluding chapter, which shows how far we have travelled since speculations on the optical medium first began. The theory of relativity and the quantum theory are not included in the scope of the book.

The volume is written for fairly advanced students, and the discussion necessarily is mainly mathematical. A great amount of work is surveyed in brief compass; and most readers will find fresh information, and arguments that are new to them. According to the author's plan, only those developments are treated which afford a means of discriminating between rival theories; and the student will do well to follow his guidance through the bewildering mass of investigations which still confront the learner, as well as through the débris of wrecked hypotheses.

OUR BOOKSHELF.

Chile. Pp. 301. (Santiago: The Chilean Government, 1915.)

THIS anonymous volume written in English is doubtless meant to diffuse a knowledge of Chile and particularly of Chilean resources and trade in English-speaking countries, but there is no preface to indicate its aim or the personality of its editor. In about fifty short chapters it contains a comprehensive survey of Chile, its life and conditions, including a good deal of statistical

matter, which might, however, in some cases be fuller and more recent. The volume, as a whole, gives a good idea of the amazing strides which Chile has made during the last century. The great drawback, however, to volumes of this nature, especially when they are anonymous, is the lack of critical spirit. In that respect this volume does not escape. The picture is painted in colours that are often too bright, with the result that it leaves one with the impression of a country so bountifully endowed by Nature as to be almost without drawbacks. For example, the chapter on climate, without ignoring the heavy rainfall, strong winds, and gloomy weather of the far south, contrives to give them considerably less space than the more beneficent Mediterranean climate further north. Apart from this criticism there are few omissions in the book, but some authentic account of the little-known Chilean possessions of Juan Fernandez and Easter Island might have been added.

The English is weak in places; sometimes the meaning must be guessed, and there are misprints on nearly every page. But the most serious charge against the book is the absence of an index and a good map. The only map is a crude, small-scale one of the railways. The numerous illustrations are excellent, but some of the expense they have entailed might profitably have been lavished on sketch maps in the text.

The Journal of the Institute of Metals. Vol. xvii. Edited by G. Shaw Scott. Pp. x+384. (London: The Institute of Metals, 1917.) Price 21s.

THE above volume contains the papers presented at the spring meeting of the Institute of Metals, of which an account has already appeared in the columns of NATURE. In addition, it contains the verbal discussion and written communications to which the papers gave rise. It is quite clear from these that the council, in organising a symposium of papers on metal melting, chose a subject which aroused very considerable interest among the members, and that some really valuable information was elicited and has now been placed on record in a form which should be of considerable utility. Equally clear is it that the subject will repay further investigation. The authorities of the Royal Mint are to be commended for having permitted Mr. Hocking to publish so much data based on many years' practice. Mr. Teisen's account of Hermansen's furnace was a very important contribution to the symposium. This producer-gas-fired crucible furnace is the outcome of the fact that owing to the scarcity of fuel and metal in Scandinavia, prices of these commodities are high in those countries as compared with Great Britain. Consequently it was necessary to build a more economical furnace than the type ordinarily used. The latter part of the volume contains the usual abstracts of current papers dealing with non-ferrous metals and alloys, and the present volume of the Journal, taken as a whole, should prove to be one of the most useful published by the Institute.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

On the Alterations of Tone produced by a Violin-"Mute."

EXPERIMENTS on the "wolf-note" of the violin or 'cello (see NATURE, June 29, and September 14, 1916, and *Phil. Mag.*, October, 1916) suggest an explanation of the well-known and striking alterations in the tone of the instrument produced by a "mute," which at first sight seems somewhat difficult of acceptance, viz. that they are due to the lowering of the pitch of the free modes of vibration of the *entire body of the instrument* produced by the added inertia. This view of the action of the mute (which was suggested by way of passing reference in my paper on the "wolf-note") has, I find, excited some incredulity, and its correctness has, in fact, been questioned in a note by Mr. J. W. Giltay in the *Phil. Mag.* for June, 1917. The following brief statement may therefore be of interest as establishing the correctness of my view of this important phenomenon:—

If N_1, N_2, N_3, etc., be the frequencies of the free vibrations of the body (in ascending order), the frequencies as altered by the addition of the "mute" are determined by equating to zero the expression (see Routh's "Advanced Rigid Dynamics," Sec. 76),

$$(N_1^2-n^2)(N_2^2-n^2)\times\text{etc.},-\alpha n^2(n_2^2-n^2)(n_3^2-n^2)\times\text{etc.},$$

where α is a positive quantity proportionate to the added inertia, and n_2, n_3, etc., are the limiting values of N_2, N_3, etc., attained when the load is increased indefinitely [$n_1=0$, and $n_2<N_1$, $n_3<N_2$, etc.]. The forced vibration due to a periodic excitation of frequency n is determined by the same expression, being inversely proportional to it except in the immediate neighbourhood of points of resonance. The sequence of the changes in the forced vibration produced by gradually increasing the load is sufficiently illustrated by considering a case in which n lies between N_1 and N_2. If $n_1<n_2$, the load decreases the forced vibration throughout, but if $n>n_2$, the load at first *increases* the forced vibration until it becomes very large, when n coincides with one of the roots of the equation for free periods, subsequent additions of load decreasing it. The *increase* in the intensity of tone indicated by this theory has actually been observed experimentally by Edwards in the case of the graver tones and harmonics of the violin (*Physical Review*, January, 1911). Edwards's observation that the intensity of tones and harmonics of high pitch is *decreased* by "muting" is also fully explained on this view, as in the case of the higher modes of free vibration of the instrument a very small load would be sufficient to make the frequencies approximate to their limiting values.

Comparison of the effects of loading the bridge of the instrument at various points on the free periods and the tones of the instrument furnishes a further confirmation of the foregoing theory. For instance, on a 'cello tried by me, the lowering of the "wolf-note" pitch produced by a load fixed on *either* of the feet of the bridge was small compared with that obtained by fixing it on top of the bridge, and the observed "mute" effect was correspondingly smaller. In fact, the alterations of free period produced by loading furnish us with quantitative data regarding the relative motion of different parts of the instrument, and of their influence in determining the character of its tones.

C. V. RAMAN.

Calcutta, August 28.

Origin of Flints.

HAVING paid some attention to the study of flints, both in England and Australia, I have read with interest the recent letters to NATURE on this question, and think that possibly some facts from this side of the globe may be worth noting. In the Cainozoic of South Australia and Victoria black flints occur which have the characteristic white coating of the English examples, and, in fact, are indistinguishable from them. They are found both in nodular and tabular form, and occur in lines parallel to the bedding. At Port Macdonell, South Australia, sheets of flint are found 2 in. or 3 in. thick, and, according to Tenison Woods, they are quarried and used for flagstones. These Cainozoic flints appear to be confined to the Miocene (Janjukian) beds, and are closely associated with the polyzoal limestone, a white, chalky deposit consisting of polyzoa and foraminifera.

The evidence of a microscopic examination of these flints goes to prove that the position held by Prof. G. A. J. Cole, that chalk flints represent a more or less complete replacement of the chalky ooze, is the only one tenable from the Australian point of view. The Australian flints are often crowded with the silicified remains of polyzoa, foraminifera, shell-fragments, and occasional sponge-spicules, the last merely included as a component of the ooze and not as selected material. During the formation of the flint the calcareous bodies are frequently dissolved, and only remnants are seen in some cases in the flint sections.

Another point in corroboration of Prof. Cole's contention (based on Liesegang's experiments) is the presence of an impervious bed underlying these Tertiary flint layers. This was pointed out long ago by Tenison Woods, who stated that well-sinkers in South Australia have observed that a layer of flint is always found immediately above the water-level. The factor of an impermeable layer inducing deposition of diffused silica is an important one, and is strongly supported in those instances where I have had an opportunity of observing it.

FREDK. CHAPMAN.

National Museum, Melbourne, Victoria,
August 17.

Butterfly v. Wasp.

I HAVE spent a good many hours lately in a Devonshire garden in which there was a border of massed mauve asters which was a great attraction to butterflies. The border measured 27 ft. by 2½ ft. only, but it was no unusual thing to see on it 150 butterflies—Peacocks, Red Admirals, Tortoiseshell, Clouded Yellows—a very wonderful sight. The object of my letter is to describe to your readers two "scraps" which I witnessed between tortoiseshell butterflies and wasps, in each of which the butterfly was victorious. The method adopted was the same in each case. The butterfly sprang on to the back of the wasp, the head of each being towards the tail of the other, and a furious rough-and-tumble took place some 6 ft. from the ground. The wasp was unable to use its sting, as the butterfly was on its back, and at the end of perhaps five seconds the butterfly, which had been buffeting the wasp with its wings, dropped to within a foot of the grass, relaxed the hold which it had exerted, and allowed its enemy to drop breathless and beaten on to the lawn.

Nature had taught the butterfly to adopt the same tactics (that of concentrating all its energy on the body of its adversary) which enabled G. Carpentier to win his fight with Bombardier Wells.

ARTHUR F. CLARKE.

The Vicarage, Rochdale, Lancashire.
September 20.

The Convolvulus Hawk-moth.

I REGRET that I must ask leave to correct a statement in my letter on this moth in NATURE of September 27. I find that it was not in the present year, but in 1902, that the lady counted seven convolvulus hawk-moths flying about the tobacco plants in her garden

HERBERT MAXWELL.

Monreith, September 29.

THE ETHNOLOGY OF SCOTLAND.

IT is as a fighting man that the Scot makes his first appearance in written history; Tacitus depicts him as ruddy in colour, big in body, strong in limb, and Germanic in origin. In 1866, when Huxley[1] described the human remains discovered by Mr. Samuel Laing in a long-cist cemetery at Keiss, Caithness, which the discoverer regarded as of early Neolithic date, but which are now rightly assigned to a much later period—an early phase of the Iron age—he had clearly reached a conclusion very similar to that of Tacitus:—

> But the existence of a tall, long-headed, fair element becomes intelligible at once if we suppose that long before the well-known Norse and Danish invasions a stream of Scandinavians had set in to Scotland and Ireland and formed a large part of our primitive population (p. 134).

Huxley regarded the Scottish people, the Irish, the Norwegians, and the Swedes as possessing a common basal stock or type. Prof. Bryce, of the University of Glasgow, who has done so much to build up an accurate knowledge of the early inhabitants of the south-west of Scotland, accepts Huxley's hypothesis, and supposes that in early Neolithic times—before the long-barrow people, of Mediterranean origin, had reached Arran—Ireland, Scotland, and Scandinavia were already peopled by the same tall, fair, dolichocephalic stock.[2] Dr. W. C. Mackenzie[3] has also come to a somewhat similar conclusion from a study of the place-names of Scotland and Ireland, but supposes that the arrival of the Scandinavian or Germanic people occurred at a post-Neolithic date. The same hypothesis has also been sturdily advocated by Mr. John Munro.[4]

Huxley preferred the term "Scandinavian" to "Germanic" when he wished to designate the tall, big-boned, fair, long-headed Scotsman, because he was well aware that this type prevails only in the western fourth of the modern German Empire. "Celt" and "Celtic," "Teuton" and "Teutonic," "German" and "Germanic," are terms which the modern anthropologist has had to abandon; all have been applied to the type of man Tacitus and Huxley had in mind, and also to physical types which are totally different. To the tall, long-headed Xanthochroi most modern anthropologists would apply the term "Nordic" in preference to "Scandinavian."

When we seek for evidence as to the time and manner in which the Nordic type reached Scot-

1 "Prehistoric Remains of Caithness." By Samuel Laing, M.P. (1866.)
2 "The Cairns of Arran." Proc. Soc. of Antiq. of Scotland, 1902, p. 75; *Scottish Historical Review*, 1905, p. 275.
3 "The Races of Ireland and Scotland." (1916.)
4 "The Story of the British Race." (1899.)

land we naturally turn to the three Scottish universities which have become centres of anthropological investigation—Edinburgh, Glasgow, and Aberdeen. We shall take the last-named university first, because the school of anthropologists which has grown up under Prof. R. W. Reid, Dr. Alexander Low, Mr. James F. Tocher, the late Dr. W. R. Macdonell, and the late Mr. John Gray can show us very precise and remarkable facts bearing on the early history of the people of the north-east of Scotland.[5] All over the county of Aberdeen are found burials in short stone-cists, which certainly date back to an early stage of the Bronze age, and have been given an approximate date of 1500 B.C. by the Hon. John Abercromby. There could not be a sharper contrast between two human types than there is between the Nordic and those squat, bullet-headed, short-cist people of Aberdeenshire. The latter were a wonderfully uniform folk, showing a peculiar type of brachycephaly. To find the nearest approach to that type in a modern population we have to go more than a thousand miles away, to the countries lying at the upper waters of the Elbe and Rhine. In the ancient graves of these same areas of central and south-west Germany the Hon. John Abercromby finds the prototype of the "beakers" which were so often placed in the Aberdeenshire short cists with the dead. Between 3000 and 4000 years ago Aberdeenshire was invaded by a brachycephalic, Slav-like people. We have ample evidence to show that the round-heads of Central Europe broke through the Nordic barrier that still guards the eastern shores of the North Sea about the end of the Neolithic period, some 4000 years ago. Nor need we hesitate to believe that they had the means to cross the North Sea. In that great work,[6] whereby a foundation for a real history of the Scottish people was laid, Sir Daniel Wilson describes the discovery of a boat at a depth of 15 ft. in the carse of Falkirk. The boat was 36 ft. long and 4 ft. wide. We know approximately when the silt of the carse was deposited and the boat embedded; it was when the 25-ft. beach marked the level of the sea and when the hunters of Scotland used that peculiar form of harpoon which marks the transition from the Palæolithic to the Neolithic civilisation. There were apparently big boats in Scotland several thousand years before the Continental or German round-heads landed on the shores of Aberdeenshire.

Unfortunately the anthropologists of Aberdeen University can show us nothing of the people who preceded the round-heads or of the people who followed them. But they have provided us with the means of ascertaining how far the stock introduced by the short-cist people has been perpetuated.[7] In 402 men examined by Mr. John Gray and Mr. James Tocher there were only 5 per cent. who had the peculiar head form and dimensions of the short-cist people; there were 9 per cent. who were technically of the round-headed type with a cephalic index of 80 or more. The prevailing forms varied between the upper limits of long-headedness and the lower of round-headedness. These modern Buchan people were, on an average, about 4 in. taller than the short-cist men and had the fair colouring in hair and eyes of the modern Bavarian. How and when the Nordic type reached Aberdeenshire we have no precise evidence. But it certainly is at present the prevailing type.

We come now to deal with the contributions which the late Sir William Turner, principal of the University of Edinburgh, made to Scottish ethnology. He may be described as one of the best Scotsmen ever born south of the Tweed. When he arrived in Edinburgh in 1854, at the age of twenty-four, to assist Goodsir, he found Daniel Wilson, who had opened so brilliantly the first chapter of Scotland's ancient history, on the point of departure for the University of Toronto, of which, in the course of time, he became the distinguished principal. Another young Englishman, the late Dr. John Beddoe, had just finished his first preliminary survey of the Scots: he found them to be a compound of Saxon, Pict (Iberian), Celtic (a hybrid between the British of the Neolithic and Bronze ages), and Welsh. Turner had a predilection for facts rather than theories, and he began to collect, in a systematic manner, the materials for a craniological history. His numerous pupils became willing assistant collectors, and in the course of fifty years he assembled in his museum the most extensive collection of ancient and modern Scottish crania that has as yet been made. When he retired from the chair of anatomy, to assume the onerous duties of principal of the University of Edinburgh, he devoted his spare hours to the study of his cranial collections. He published two monographs[8] on the Scottish crania, the first, issued in 1903, being a detailed description of 176 skulls of modern people; the second issued in 1915—a few months before his death at the age of eighty-four—in which he gave an account of prehistoric crania and stated his conclusions regarding the races which had become fused to form the Scottish nation. He had, including the Aberdeenshire series already mentioned, forty-nine skulls from short stone-cists, representing Scotsmen of the Bronze age. Of the forty-nine, thirty-eight were discovered in the eastern counties; of these, thirty-four were brachycephalic, of a type very similar to the Aberdeenshire series, yet showing a sufficient degree of difference to lead one to suspect that there was at least a tribal distinction.

Turner agreed that the people buried in the short stone-cists were Alpine or Central European in origin and represented the Bronze-age

[5] See Proceedings of the Anatomical and Anthropological Society of Aberdeen University of December, 1902, and subsequent dates.

[6] "The Archæology and Prehistoric Annals of Scotland." By Daniel Wilson. (1851.)

[7] "Physical Characters of the Adults and School-children of East Aberdeenshire." By John Gray and James F. Tocher. Journ. Roy. Anthrop. Inst., 1900, vol. xxx., p. 104.

[8] "Contributions to the Craniology of the People of Scotland." Part I. Trans. Roy. Soc. Edin., 1903, vol. xl., p. 547; part ii., 1915, vol. li., p. 171.

invaders of Scotland. Of the more ancient Scots, those who buried their dead in chambered cairns in the latter part of the Neolithic period, he had only ten examples, five of these being borrowed from Prof. Bryce's Arran series. These chambered-cairn men are as different from the short-cist men in head form as men can be; the people from the chambered cairns have the same cranial shape and dimensions as the people of the long barrows of England. Turner accepted the opinion that both were of the same race and that they were traceable to a Mediterranean stock. One cannot help being impressed by the length and relative narrowness of the face of the more ancient Scottish skulls; we seem to see in them already the peculiar traits so common in the faces of modern Scots.

Sir William Turner had at his disposal two crania which may possibly belong to an earlier date than the skulls from the chambered cairns. They were found by the late Dr. Joseph Anderson, when he discovered and opened the MacArthur cave at Oban in 1895. We know that the MacArthur cave was inhabited at the very earliest phase of the Neolithic period, but as one of the skulls was on the floor of the cave and the other—a very remarkable skull—was only embedded in the upper shelly stratum, we cannot be certain that they represent the ancient inhabitants of the cave. They are both of the Neolithic Scottish type. The more deeply embedded cave skull has a remarkable resemblance to that of Robert Burns; as seen in profile they are almost identical. The cave skull has the remarkable length of 205 mm., that of Burns 206 mm.; they are almost identical in height of vault, but there is a decided difference in width—that of the cave skull being 138 mm., while Burns's cranium had a width of 155 mm. The poet had an enormously capacious skull. The essential differences between the few Neolithic Scots we know of and their modern successors lie in an increased stature and an increased width of head in the latter.

Of the people who lived in Scotland in the early Iron age, the people who succeeded the short-cist round-heads, Sir William Turner had to own we know almost nothing. They apparently burnt their dead. But he accepts on faith that with the introduction of iron a Celtic people came—a long-headed race, which gave the modern impress to the Scottish type. It is possible, as Sir William Turner agreed, that the human remains discovered by Dr. Edward Ewart on the shores of the East Lothian in 1911 may represent people of the early Iron age; in all their physical characters they are akin to the Scots of the Neolithic period. When Sir William Turner came to examine the skulls of the modern Scottish people he found that the cemeteries on the East Coast—particularly in Fife and in the Lothians—carried convincing evidence that the short-cist stock was not extinct. In some cases—particularly in Fife—there were communities in which the round-heads still formed 50 per cent. of the inhabitants and more; of seventy-nine skulls from cemeteries in the Lothians 25 per cent. were brachycephalic, while amongst thirty-one skulls from Renfrew, on the western side of the country, there was not one. The course of twenty or thirty centuries had failed to diffuse the round-headed invaders of the Bronze age among the more ancient long-headed people of the west. He admitted that there must be a Welsh, a Danish, a Scandinavian, and a Saxon element in the modern Scottish, but he would have been the first to admit that the origin of the real bulk of the Scottish people—the descendants of Gaelic-speaking ancestors—remains still an enigma.

We have now to turn for a moment to the conclusions reached by the Anthropological School of the University of Glasgow. From his exploration of the chambered cairns of Arran and of the south-west of Scotland Prof. Bryce draws certain definite inferences.[9] He finds the prototype of their burial cairns in the north of Ireland; we may infer that 4000 years ago or more there existed already a connection and intercourse between the peoples of the north of Ireland and the south-west of Scotland. He agrees that these chambered-cairn Neolithic folk were of the Mediterranean stock; their culture is of the South. He is further of opinion that when these cairn people were entering the back door of Scotland on the west the short-cist, round-headed people from the Continent were entering the front door on the east. The east and the west met in Scotland, but to what degree they mixed we have already seen from Sir William Turner's investigations. How far the west was left untouched by the round-heads, and the extent to which the English and the West Scottish have been evolved from a mixture of similar human stocks, have been brought out vividly by the investigations of Dr. Matthew Young, at one time assistant to Prof. Bryce. In 1916 Dr. Young published a monograph[10] describing the dimensions, characters, and variations seen in a collection of skulls—above 600 in number—derived from a comparatively modern burial ground in Glasgow. In this swatch of the modern population of that great city he found that the round-heads amounted to only 2·2 per cent., against 25 to 30 per cent. presented by several cemeteries on the East Coast. The most remarkable result of his labours, however, was the discovery of a close similarity between the Glasgow skulls and the collection from Whitechapel described by the late Dr. W. R. Macdonell. The degree of resemblance will be seen by comparing some of the chief mean measurements of skulls of adult males:—

	Max. length mm.	Max. width mm.	Average height mm.	Bizygomatic width of face mm.	Length of upper face mm.
Glasgow ...	187·5	139·5	117·0	127	70·9
Whitechapel	189·06	140·6	114·59	130	70·1

[9] *Scottish Historical Review*, April, 1905, p. 275; Proc. Soc. of Antiq. of Scotland, 1902, p. 75.

[10] "A Contribution to the Study of the Scottish Skull." Trans. Roy. Soc. Edin., 1916, vol. li., p. 347.

We are not surprised to note that the Scottish face is somewhat longer and narrower, but we were not quite prepared to find that the Londoner had the larger head. Nor need we really be surprised to find so close a similarity between samples of the population culled from the Clyde and from the Thames estuaries when we remember that since the close of the Bronze period British invaders and immigrants have invariably been members of the Nordic stock. We do not know when that stock first settled in Britain, but it is difficult to account for all the facts now at our disposal unless we accept Huxley's hypothesis that it reached Britain very early—probably, as Prof. Bryce supposes, at an early Neolithic or even more ancient date.

A. Keith.

THE BEGINNINGS OF PORCELAIN IN CHINA.

In a charming series of essays on "Fallen Idols," the late Mr. M. L. Solon, of Stoke-on-Trent—one of our most learned students of the history of ceramics—discussed some types of antique pottery which he ranked among the "transient glories of the world," because at one period these vessels, made from common clay, were the idols of the hour, and exceeded in value vessels made from the most precious materials. The idols were but fleeting fashions which have now lapsed into obscure tradition. It is the work of the archæological ceramist to inquire into the nature and character of the pottery of ancient days. In many cases the greater the obscurity and the fewer the number of available facts, the more persistent have been the attempts to illumine dark and hazy tradition by extravagant conjectures. By a curious aberration of the human mind, the absence of positive evidence is very prone to engender assurance and confidence; this condition has ever been an *ignis fatuus*, luring the unwary into quagmires of fancy. What whimsical and grotesque views have grown about the murrhine vases, the *ollae fossiles*, and the buccaro vases! What curious myths have been current with respect to the origin of Chinese porcelain!

It is a pleasure to read Laufer and Nichols's brochure[1] on the beginnings of porcelain in China because here positive evidence occupies an all-important place. The essay should be read in conjunction with Laufer's "Chinese Pottery of the Han Dynasty." The materials for the latter work were collected by Laufer while on a mission in China about 1903 under the auspices of the American Museum of Natural History, and this work was supplemented by a later investigation in China about 1910.

The composition of the Han pottery, as represented by chemical analyses, is a close approximation to that of the better-class Chinese pottery, and the inferior quality of the body of the former appears to be due to the primitive methods of manufacture prevalent in China during that epoch. The porosity, for example, is much greater than that of ware which is usually styled porcelain; indeed, the authors go so far as to call the body a "porcelain froth." This term, of course, is merely a metaphor and is no doubt intended to emphasise the low porosity of the ware. According to Nichols, the *outside* of one vessel he examined was coated with a white slip, and on this was superposed a red glaze. The *inside* of the vessel was coated with a glaze which appears to have been made by mixing the body material with limestone—in the approximate proportion of one of limestone to two of body. Analyses of the green glaze of another specimen correspond with a glaze of the Rockingham type, but without "alumina," and the colour is due to the presence of about 3 per cent. of copper oxide. The crude character of the body is taken to mean that the Han pottery is the "forerunner of true porcelain," and that

> it represents one of the initial or primitive stages of development through which porcelain must have passed before it could reach that stage of perfection for which the Chinese product gained fame throughout the world.

Although many students of pottery consider that true Chinese porcelain first appeared in the Ming dynasty about the fourteenth century, and others carry it back to the Sung dynasty about the tenth century, there are several references to porcelain at an earlier period still—*e.g.* the seventh century—but the controversy on the origin of Chinese porcelain now turns on the meaning which the Chinese assigned to the term *ts'e*, and on the definition of porcelain. If the Han pottery is a porcelain, we can accept Laufer and Nichols's conclusion, and the beginning of porcelain would be carried to near the beginning of the Christian era; but did the term *ts'e* refer to ordinary pottery or to porcelain? There is no mistaking Laufer's view:—

> By arguing that in the beginning the term *ts'e* denoted nothing but ordinary pottery we close our eyes to the real issue and act like the ostrich; in this manner we utterly fail to comprehend the process of evolution of porcelain.

He claims that the term *ts'e* refers to a porcelain-like pottery and should be translated by "porcelanous ware" or some equivalent term, and that the early *ts'e* is represented by the Han pottery. This is scarcely the place to argue this matter, because so much depends on the meanings of the terms employed. The present writer, who knows nothing of the Chinese language, has always taken the early *ts'e* to have been a general term which covered *both* ordinary pottery and porcelain. Laufer's general conclusion that the Han pottery was the immediate precursor of porcelain will no doubt be generally accepted, because the experience gained with this pottery would naturally point the way to the manufacture of higher types of ware. I have shown several experienced men some fragments of the Han pottery which

[1] "The Beginnings of Porcelain in China." Publication 192 of the Field Museum of Natural History, Anthropological Series, Chicago, vol. xvi., No. 2, 1917.

Mr. Laufer has very kindly sent to me, but none considers that the ware itself can be called porcelainic.

Laufer also has a section entitled "Historical Notes on Kaolin," and he shows that no real conclusion as to the origin of Chinese porcelain can be drawn from a consideration of the history of kaolin. It might be added that similar remarks apply to the manufacture of porcelain in Europe, for, contrary to the general belief, it can be proved that the required white-burning clay was a well-known article of commerce in Europe long before the method of making porcelain was developed by Böttger early in the eighteenth century. The Chinese appear to have adopted glazing near the beginning of the Christian era, and Laufer accepts Hobson's conclusion that the idea of glazing pottery was derived directly from the West, by contact with the Hellenistic world, in comparatively late historical times. Although a knowledge of glazing was necessary before the Chinese could manufacture porcelain ware, yet in this achievement "the creative genius of the Chinese was not guided by outside influences, but relied on its own powerful resources."

J. W. MELLOR.

NOTES.

AN exhibition of medical war specimens will be opened in the museum of the Royal College of Surgeons of England, Lincoln's Inn Fields, by Sir Alfred Keogh, G.C.B., Director-General of the Army Medical Service, on Thursday, October 11, at 3 p.m. The greater part of the exhibition is devoted to specimens collected by officers of the R.A.M.C. during the present war, but there are also representations of the wounds and injuries of former wars, borrowed from the museums of the College of Surgeons, of the Army Medical College, Millbank, of St. Thomas's Hospital, and of University College Hospital. The specimens have been prepared and arranged by the members of the museum staff of the college. At the same time, the honorary fellowship of the college is to be presented to Sir Alfred Keogh.

A NATIONAL institute is to be established in Italy having for its objects the investigation of the relations between malaria and agriculture, the study of the direct and indirect causes of the unhealthiness of malarial districts, and the organisation of a campaign against those causes.

WE note from *Engineering* for September 28 that the operation of lifting into place the central span of the new Quebec Bridge was completed successfully on Thursday last, September 27. The work was commenced on Tuesday, and extended over three days. The weight of the span is about 5000 tons, and the height of lift 150 ft.

THE council of the Chemical Society announces that three lectures are to be given at the ordinary scientific meetings during the forthcoming session as follows:—December 6, "The Relation between Chemical Constitution and Physiological Action," Dr. F. L. Pyman; February 21, 1918, "Recent Studies on Active Nitrogen," Prof. the Hon. R. J. Strutt; April 18, the Hugo Müller lecture, entitled "The Old and the New Mineralogy," Sir Henry A. Miers. It is also hoped to announce at a later date that Dr. Horace T. Brown will deliver the lecture entitled "The Principles of Diffusion: their Analogies and Applications," which was unavoidably postponed last session. Arrangements have also been made for informal meetings to be held on November 15, March 21, and May 16.

WE learn from the *Secretary*, the journal of the Chartered Institute of Secretaries, that a *questionnaire* was recently circulated among members of the institute in order to obtain opinions as to the desirability of adopting a decimal system in place of the present British coinage, and the substitution of the metric system for the existing United Kingdom weights and measures. Of those who replied, 85 per cent. favoured a change to a decimal system of coinage as likely to be beneficial to the business in which they were engaged; and of the replies which expressed a preference, 66 per cent. favoured a £ basis of coinage rather than an "Imperial crown" or dollar basis. To an inquiry as to whether overseas business was hindered by the use of the present British coinage 50 per cent. of the replies indicated that this business was not so hindered; while in 64 per cent. of the replies a decimal system has been found of service for internal purposes in the business. In the case of weights and measures, 86 per cent. of the replies favoured a change to the metric system, and 53 per cent. of these had already adopted the change. Improved and extended business relations with traders in other countries were reported in 75 per cent. of the replies favouring the change. In 61 per cent. the business is stated to be hindered by the use of British weights and measures.

THE jubilee of the Albert Institute of Literature, Science, and Art, Dundee, was commemorated on September 20. It took its origin from the desire to perpetuate the memory of the Prince Consort by erecting a building devoted to the furtherance of the subjects which had occupied so much of his attention. The movement began in 1863, and the Town Council, when giving ground for the building, stipulated that accommodation should be provided within the structure for a free public library, in the event of Dundee adopting the Library Act. The Albert Institute was designed by Sir G. Gilbert Scott, and was opened in September, 1867, when the British Association occupied the Albert Hall in the building, and the public library was begun. An additional building was erected in 1872 as a museum and picture gallery, and ultimately the whole structure was handed over to the community. The story of this institute is one of continual progress. Large additions were made to the museum in 1887, and a separate technological museum was established in 1900. The libraries now consist of central lending and reference libraries, six branch libraries, partly paid for during the past ten years by Mr. Andrew Carnegie, two museums, two sculpture galleries, and six picture galleries. The donations to these departments in buildings, books, specimens, and pictures amount to more than 160,000*l.*, given by citizens and by Mr. Carnegie. At present the libraries contain 170,000 volumes, and the annual issue is about 420,000 volumes. The museums have departments for natural history, ethnography, geology, and technology. The picture galleries contain representative works by eminent modern artists. At the commemoration addresses were delivered by Principal Sir John Herkless, Dr. Hew Morrison, Bailie Martin, Dr. John Ross, Mr. R. F. Martin, and others.

MR. RUFUS D. PULLAR, head of the well-known firm of Messrs. J. Pullar and Sons, Perth, whose death in Edinburgh on September 22 we recorded last week, was born in Perth in 1861, and was the elder son of Sir Robert Pullar. The firm was founded in 1820, and

afterwards became one of the largest dyeworks in Great Britain, having a floorage area of more than 100,000 square yards, and being equipped for cleaning, dyeing, and finishing every kind of textile material. As a young man Mr. Pullar studied chemistry at Edinburgh University and the Yorkshire College at Leeds, and he visited the most important dyeworks in France, Germany, Switzerland, and the United States. Since the outbreak of war he spared neither time nor labour in the national cause, and was prominently associated from the beginning with Government action concerning the development of British chemical industries, particularly the colour industry. Mr. Pullar was connected with nearly all the philanthropic and educational movements in his native county. He was a fellow of the Chemical Society, a member of the Society of Chemical Industry, and for the two years 1915–16 was president of the Society of Dyers and Colourists, and chairman of the Dyewares Supply Committee formed by that society in October, 1914. In December, 1914, he was appointed a member of the Board of Trade Advisory Committee, which was entrusted with the difficult task of drafting a scheme to ensure the manufacture of dyes in this country on an adequate scale. This ultimately led to the formation of British Dyes, Ltd. He was also a member of the Provisional Committee of the Association of British Chemical Manufacturers. His membership of the Perthshire Appeal Tribunal and his duties as a Commissioner under the National Service scheme also made a heavy draft on his energies, and his many public activities, coupled with some recent labour difficulties, led to a breakdown in his health.

By the death of Philippe de Vilmorin on June 30, at the early age of forty-five, a notable and brilliant figure has been removed from the horticultural world, one that science can ill afford to lose. Inheritor of a great name, and head of a great firm with unrivalled resources, de Vilmorin placed both freely at the service of the science to the interests of which he was devoted. The precision in methods of plant-breeding which Mendel's discovery introduced at once appealed to him. He started experimental work in these directions, and some of his results with wheat and peas have already been published and are well known to geneticists. But while deeply interested in the purely scientific side of genetic studies, de Vilmorin was fully alive to their immense practical importance, and gave every encouragement to his staff at Verrières-le-Buisson to work along these lines. The achievements of Louis and Henri de Vilmorin, his father and his grandfather, had made him realise that the continued prosperity of a great and progressive firm must depend eventually upon the attitude adopted towards scientific discovery. He was actuated by an earnest desire to bring the so-called practical and the scientific workers into closer contact with one another, and spared neither time nor means to effect his object. A great opportunity came to him when the fourth International Congress on Genetics met at Paris in 1911, and de Vilmorin availed himself of it to the utmost. He undertook the arduous work of secretary, in which position his influence and prestige were exerted to bring together for their mutual profit a representative gathering from horticultural and biological circles. His great personal charm played no small part in making the congress the great success that it undoubtedly was. He undertook the further task of collecting and editing the contributions made to the congress, and the beautiful and valuable volume of reports issued owes as much to his enthusiasm as to his generosity. De Vilmorin also assisted in the progress of horticulture in other directions. He published papers on the beet-sugar industry of the United States, on the culture of ginseng in Korea and Manchuria, and on the tobaccos of commerce. He was also responsible for three important publications of his firm—"Les Fleurs de Pleine Terre," "Le Manuel de Floriculture," and the "Hortus Vilmorinianus." The first two are standard works on flower gardening, while the last is a valuable report on the behaviour of rare and little-known plants tested by the firm. Philippe de Vilmorin filled a unique place in the scientific world. No man was better endowed for helping to bridge over the gulf that long existed between the horticulturist and the botanist, between the garden and the laboratory. He played a great part in such success as has already been achieved. He would have played a greater part had his life been spared.

The question of the religious or magical significance underlying the customs of bull-baiting or cattle-driving has been discussed without much result. Mr. W. Crooke, in *Folk-Lore* (vol. xxviii., No. 2), has collected a number of instances from India and elsewhere in which, at the critical seasons of agriculture, particularly at the sowing and transplanting of rice, the plough cattle are driven from their stalls and exposed to considerable violence. This may be conjectured to be a method of arousing their vitality and that of the crops. The late Major Tremearne believed that the form of bull-baiting practised in Nigeria was probably a fertility rite. The question is still obscure, and much more material must be collected before any definite conclusion can be reached.

In the September issue of *Man* the Rev. A. T. Bryant describes the Zulu cult of the dead. Their religion makes no definite statement on the doctrine of the immortality of the soul. The soul is generally believed to survive death, and sacrifice is offered to it practically continuously for an indefinite period of time; but how long it will continue to live, and whether or not it will endure for ever, are not defined. A man dies, but only in his flesh; his spirit still endures; if it does not go to the bosom of Nkulunkulu, the Creator, it goes where he is supposed to be, to the nearest veldt. There it becomes changed, and in due course reappears in visible form in the guise of a snake—not a previously existing snake, but it simply materialises into one. To kill one of these spirit snakes was in former times a serious offence, and tests are prescribed by which such snakes can readily be identified, one distinction from other varieties being that they are all harmless.

Prof. Futaki discusses the cause of typhus fever in *The New East* for August (vol. i., No. 3). He and his co-workers claim to have demonstrated the presence of a delicate spiral micro-organism or spirochæte in this disease. It measures 6–8 microns in length, and is mostly found in the kidneys and suprarenal capsules. Monkeys can be infected by injection of the blood of a patient at an early stage of the disease, and similar spirochætes are present in the monkey's kidney.

In *Science* for August 17 (vol. xlvi., No. 1181) Mr. N. A. Cobb contributes a general article on *intra-vitam* staining of tissues. For the examination of such objects perfectly corrected lenses must be employed, and Mr. Cobb recommends the use of one apochromatic objective (2 mm.) as a condenser for another apochromatic objective. This necessitates mounting the object to be examined between two thin cover-glasses, which may be supported upon a special carrier. By this arrangement the condenser objective may be brought into proper focus.

In a circular issued by the Local Government Board attention is directed to the probability of the occurrence of indigenous cases of malaria in England.

This is rendered possible by the return to England of numbers of men who have had malaria in the Eastern campaigns. These men in many instances still carry the parasites in their blood, and, given the presence of the intermediary anopheline mosquitoes, considerable risk of the transmission of the disease must exist. In fact, cases of indigenous malaria arising in this way have recently been recorded. The Board invites the co-operation of medical practitioners and medical officers of health, and has made arrangements whereby specimens of blood may be examined. Inquiries are also being instituted into the local prevalence of anopheline mosquitoes.

A very useful pamphlet on bee plants and their honey has been drawn up by Mr. Grieve, of Whin's Vegetable Drug Plant Farm and Medicinal Herb Nursery, Chalfont St. Peter, Bucks. The various useful bee plants are referred to in special paragraphs, and notes of value as to the plants themselves and the character of their honey are given. The time of year at which the plants are in flower is also mentioned. Some attention is paid to poisonous honey, and the classic case of the rhododendron and azalea honey near Trebizond referred to by Xenophon is quoted. The uses of honey, its quality, and also the treatment of bee stings are given their due share of attention, and the pamphlet should prove of value to all interested in the beekeeping industry.

We have received Bulletin No. 10 of the Department of Fisheries of the United Province of Bengal and Bihar and Orissa. It is a statement of the quantities of fish imported into Calcutta in the year ending March 31 last. The promptitude in publication is to be remarked, but this is explained by the circumstance that the data are evidently copies of "traffic returns," being statements of the quantities of fish carried by the various railways and other means of conveyance. No mention of the kinds of fish, or of their value, is given.

A description of the Gymnosomatous Pteropods of the coastal waters off Ireland is given by Miss Anne L. Massy in the July number of the Proceedings of the Royal Dublin Society. The report is interesting because of our meagre knowledge of the group as it exists in British and Irish seas. The collections were made, by plankton and other nets, by the Irish fishery cruiser *Helga* off the west, south, and east coasts of Ireland during the years 1901–4. The Pteropods are not an abundant group among the specimens taken by the *Helga*, and they occur mostly in deep water between latitudes 50° to 52° N. and longitudes 11° to 13° W. Miss Massy has identified twelve species, and six of these are new to science, while four others are now recorded, for the first time, from British or Irish seas. Most of the species are deep-water forms, but one, *Pneumodermopsis paucidens* (Boas), is a shallow-water animal, and is fairly common between Inishbofin (in County Galway) and St. George's Channel, and is abundant enough to be of some value as a source of food for fishes.

We have received from Dr. C. C. Easterbrook the interesting reports of the Crichton Royal Institution, Dumfries, for 1913 and 1914, as bearing upon the review by Sir Robert Armstrong-Jones of "Shell-shock" in Nature of September 6, and entitled "The Psychopathy of the Barbed Wire." In specially marked paragraphs these reports emphasise (*a*) the definite dependence of the mind upon the body, "for mental illness, like other illnesses, is primarily a matter of derangement of health"; further, "in mental affections the mental machinery (*i.e.* the cells of the cerebral cortex) is disordered in its working and thrown out of gear"; (*b*) the concern expressed by all psychiatrists long before the war that mental disease among the poor should receive statutory sanction for treatment without the medical certificate, which, when issued, registers insanity as well as pauperism. As stated by Sir Robert, these suggestions made by the authors of "Shell-shock, etc.," are plainly the reflection of the considered opinion of all those who practise among the mentally afflicted. They have for many years urged the early treatment of these cases, both in the interests of the patient, who recovers earlier, and upon grounds of public economy. Lastly, (*c*) the reports show the dependence of mental illness upon the nervous or neurotic constitution, which "is a precursor of and a *sine qua non* of an attack of insanity." The reports support the view that the nervous constitution "is to be found among the nearer blood-relations." Although Dr. Easterbrook criticises the inferential value of hereditary histories of nervous and mental diseases, he yet derives "anomalous dispositions" in great part from racial, ancestral, and familial traits, with the result that the sufferer "loses his nerves" in consequence of a faulty heredity.

Red sandal (*Pterocarpus santalinus*, Linn., f.) was formerly valued for the red colouring matter santalin found in the heart-wood, and was exported to Europe from Madras in large quantities for use as a dye. This use outside India has been superseded by aniline dyes, and the wood is now used for the construction of house-posts, as it is never attacked by white ants. The tree grows on the slopes of the Cuddapah and neighbouring hills in the Madras Presidency, and a useful account of the tree and its growth, etc., with a map of its distribution and photographs, is given by Mr. T. A. Whitehead in Forest Bulletin No. 34, India. "Redwood" was frequently used as ballast in home-going ships in early days, and was referred to as "Caliature," a name which Rumphius traces to the town of Kistnapatam, eighty-two miles north of Madras, which, according to an old glossary, is the Greek Sopatma, or otherwise "Calitore." In a Portuguese map of 1672 a village Caletur is indicated, and it is interesting that, though the place was known to foreigners as Calitore or Caletur, it was not recognised by that name by British factors.

Towards the middle of June in the present year considerable tracts of the Pennine Hill pastures were found to be infested with the caterpillar of the antler moth (*Charaeas graminis*, L.) in extraordinary numbers, causing serious damage to the grazing. The outbreak was investigated at the time by officers of the Board of Agriculture and others, and forms the subject of two reports which are published in the August issue of the Board's *Journal*. Messrs. A. C. Cole and A. D. Imms contribute a report on observations in the Peak District. They record that the principal grass attacked was that known locally as "bent" grass (*Nardus stricta*), whilst cotton grass (Eriophorum) and other species appeared to suffer less severely. The more succulent and finer grasses escaped attack, as did also bilberry, white bedstraw, heather, and bracken. The altitude appeared to be a distinct factor in the limitation of the infestation, no caterpillar being found at an elevation less than 900 ft., although from that altitude up to 1700 ft. it was prevalent. The two most efficient barriers were found to be water and stone walls. These observations are substantially confirmed by Mr. J. Snell's report on the outbreak in Yorkshire. He also found *Nardus stricta* to be badly attacked, and further observed the caterpillar feeding on *Aira*

caespitosa, some of the finer grasses, and other plants. Messrs. Cole and Imms offer suggestions as to possible causes of the outbreak, and both reports agree in recommending the cutting of trenches across the grassland as a preventive measure. The effectiveness of spraying measures is also discussed.

THE cutting off of supplies of potassium salts from the German deposits has forcibly directed attention to other sources hitherto neglected. Of the many waste products investigated few appear to offer better prospects of economic utilisation than the flue-dust of blast-furnaces. That soluble potassium salts are present in these flue-dusts is no new discovery, but only of late have they received serious consideration. According to tests by Mr. H. T. Cranfield, published in the August issue of the *Journal of the Board of Agriculture*, the potash-content of these flue-dusts is extremely variable, the total (acid-soluble) potash ranging in the twelve samples quoted from 2·97 to 15·89 per cent. K_2O, whilst the water-soluble potash ranged from 1·23 to 9·25 per cent. The flue-dusts vary greatly in colour, and, generally speaking, the lighter-coloured materials are richest in potassium salts. Potassium sulphate is the principal of these salts, the chloride being also present in smaller proportion. It is suggested that the total annual output of potash in these flue-dusts is probably not fewer than 15,000 tons, of which quite one-half is soluble in water. These data furnish adequate justification for the Order recently issued by the Ministry of Munitions whereby the sale and treatment of blast-furnace dust are brought under control.

IN continuation of the experiments on the temperature-gradient in the lavas of Kilauea, referred to in NATURE of June 28 (vol. xcix., p. 352), Mr. T. A. Jaggar, jun., records that bright lines in the lava-lake give temperatures of about 1020°—that is, about 250° above those of the lake magma 3 ft. below the surface (Bull. Hawaiian Volcano Observatory, March, 1917, p. 34). The same author contributes an article on "The Thermal Gradient at Kilauea" to the Journal of the Washington Academy of Sciences, vol. vii., p. 397, in which he further emphasises the generation of heat at the surface "through completion of the reaction between rising unstable gas mixtures and through union with atmospheric oxygen." The liquid lava in the lake is 14 metres deep, and rests on a seemingly pasty bottom. The lower 5 metres of the lake have a temperature of 1120° to 1170°; this is attributed to the release of air from foundered blocks, which reacts with the volcanic gases and produces reheating.

THE mean monthly temperatures of the surface waters of the Atlantic Ocean north of lat. 50° N. are the subject of a paper by Dr. C. Ryder which appears as one of the publications of the Danish Meteorological Institute. In 1892 the institute published the isotherms for six months of the year calculated from fourteen years' observations. The present paper marks a great advance, for it comprises all months of the year, is based on forty years' observations, and extends to lat. 50° S. Most of the observations are from Danish vessels, and unfortunately data are lacking for the sea a few degrees east of Iceland in most months. A chart is given for each month of the year, based on the mean temperatures calculated for stations of 1° squares. The information is also tabulated in mean values for the four decades of the period covered. This arrangement was desirable for many reasons, not least because the transition from steam to sail resulted in certain areas being more frequented in some decades than in others. Perhaps the most instructive chart is that on which the isotherm of 9° C. has been drawn for all months of the year. The January, February, and March isotherms almost coincide. In April the northern trend is marked in the east, and in succeeding months the isotherm swings north until it touches the north-west and south-east coasts of Iceland in August. Then again it withdraws southward. In the west there is far less divergence between the relative monthly positions of the isotherm, for the cold southward current is maintained throughout the year.

THE problem of temperature measurement and the pyrometric control of furnace-casting and ingot-teeming temperatures in steel manufacture is one the importance of which it would be difficult to overrate. Hitherto on account of its supposed difficulty its solution has not been attempted. Publication No. 91 of the Technologic Papers of the Bureau of Standards is therefore to be welcomed in that it takes up this problem, and the conclusion reached by Dr. Burgess, the author, is that it does not really present serious difficulties or uncertainties. Observations have been taken in several steel plants. The most satisfactory instrument to use is an optical pyrometer using monochromatic light, and permitting observation from a distance of streams of metal. It is shown that the necessary corrections to the observed readings for emissivity of metals and oxides to give true temperatures are sufficiently well known, but there may be uncertainty in the case of liquid slags. For streams of liquid iron or steel the most probable value of emissivity to take, with a pyrometer using red light of wave-length $\lambda=0{\cdot}65\ \mu$, is $e=0{\cdot}40$, corresponding to a correction of 139° for an observed temperature of 1500° C. The value of e for liquid slags is usually about 0·65, but varies with the composition of the slag. It appears from the author's results that the temperatures of the roof of an open-hearth furnace bear no necessary relation to that of the metal bath, which again it is shown may have zones of considerable differences in temperature, depending upon the operation of the furnace. The temperature of the roof of an open-hearth furnace, depending upon the firing practice, may vary very rapidly, and within wide limits, from 1550°–1750° C. That of the bath is usually kept between 1600° and 1670° C. There appears to be a remarkable degree of uniformity in casting temperatures actually acquired by the melters in practice. Thus for nineteen consecutive Bessemer heats the teeming temperatures of the ingots were all between 1500° and 1555° C., and a similar degree of concordance was found in the open-hearth practice of several mills.

IN view of the importance of Fourier's series in physical applications, much interest attaches to a paper by Prof. H. S. Carslaw on "A Trigonometrical Sum and the Gibbs Phenomenon in Fourier's Series" (*American Journal of Mathematics*, vol. xxxix., No. 2, 1917). In this paper Prof. Carslaw gives a proof of the property first noticed by Gibbs, namely, that when a function becomes discontinuous the sum to infinity of its Fourier expansion does not always merely change at an infinitely steep gradient from the initial to the final value of the function, but that in certain cases it may, in the neighbourhood of the discontinuity, fluctuate between a maximum and a minimum value *outside* the limits of value of the function itself. In other words, the maximum and minimum values of the sum of a finite number of terms of the expansion, just before and after the discontinuity, may be outside the limits of value of the function itself, the maximum exceeding the larger value of the function, and the minimum being less than the smaller value by amounts which remain finite, even if the number of terms be increased indefinitely. The proof is well illustrated by the diagrams at the end of Prof. Carslaw's paper, not-

withstanding the fact that similar diagrams for the expansion considered in the paper have frequently occurred in text-books.

THE business of the *Electrician* Printing and Publishing Co., Ltd., having been acquired by Messrs. Benn Bros., Ltd., 8 Bouverie Street, E.C.4, the forthcoming books of the former company, announced in NATURE of September 20, will be published by Messrs. Benn.

OUR ASTRONOMICAL COLUMN.

SEPTEMBER METEORS.—Mr. Denning writes that a fair number of meteors, including several brilliant fireballs, were observed in September. There was a well-defined shower, not far from the Pole, at 314°+79° at the middle of the month, and at the period from September 19–24 the chief radiant points were at 4°+27°, 59°+35°, 271°+22°, 290°+52°, 343°+14°, and 352°+2°. A very brilliant meteor was observed on September 21 at 10h. 3m., from the radiant in Cygnus. As seen from Bristol it was brighter than Venus, and fell from a height of 67 to 28 miles. On September 23, at 7h. 42m., a fireball illuminated the sky as seen from Clevedon, and it had a long, slow, and nearly horizontal flight from a radiant at 322°−23° in Capricornus. Its path was about 166 miles from over the English Channel to Welshpool, and it descended from 64 to 32 miles. Though it had a very extended path, only two observations of it were received, viz. from Clevedon (Somerset) and Fowey (Cornwall), but the sky was cloudy at many places.

COMET 1916*b* (WOLF).—The following is a continuation of the ephemeris, for Greenwich midnight, given by Messrs. Crawford and Alter in Lick Observatory Bulletin No. 295:—

1917		R.A. h. m. s.	Decl. ° ′ ″	Log Δ	Brightness
Oct. 4	...	23 38 17	−1 8 2	0·0891	1·22
6	...	38 22	1 45 27	0·0972	
8	...	38 31	2 21 9	0·1055	1·10
10	...	38 43	2 55 5	0·1141	
12	...	38 58	3 27 14	0·1227	0·99
14	...	39 18	3 57 37	0·1315	
16	...	39 41	4 26 13	0·1404	0·89
18	...	40 7	4 53 3	0·1495	
20	...	40 38	5 18 9	0·1586	0·79
22	...	41 13	5 41 33	0·1678	
24	...	41 51	6 3 16	0·1770	0·71
26	...	42 34	6 23 21	0·1863	
28	...	43 20	6 41 51	0·1956	0·63
30	...	44 10	6 58 49	0·2049	
Nov. 1	...	45 3	7 14 17	0·2142	0·56
3	...	23 46 0	−7 28 20	0·2235	

The comet is situated below the Square of Pegasus, and is well placed for observation. It is, however, much fainter than might have been expected from the fact that it was discovered more than a year before perihelion passage. Between August 13 and August 22, according to observations by Quénisset, the magnitude of the comet fell from 8 to 9.

A COLOUR SCALE FOR STARS.—An attempt to establish a scale of colours adapted to observations of stars and planets has been made by Prof. W. H. Pickering (*Popular Astronomy*, vol. xxv., p. 419). The numerical values assigned to the different colours are:—5, deep-blue; 6, sky-blue; 7, light-blue; 8 pale-blue; 9, bluish-white; 10, white; 11, yellow; 12, orange; 13, reddish-orange; 14, orange-red; 15, light-red; 16, deep-red. The typical colours are shown in circular patches on a coloured plate, which is to be viewed by one eye under carefully adjusted illumination, while the planet, or star out of focus, is viewed with the other eye at the telescope. To secure constant conditions of comparison, the illuminating source is to be slightly modified as required, so that certain standard stars of type K always register 11. The average results for stars of different types are compared with the colour indices (differences between photographic and visual magnitudes) in the following table:—

Type	Colour scale		Colour index
Oe	7·0	...	—
B	6·7	...	−0·3
A	7·4	...	0·0
F	7·6	...	+0·3
G	9·5	...	+0·7
K	11·5	...	+1·2
M	12·0	...	+1·6
N	13·7	...	+2·5

An extensive investigation of star colours has also been made by H. E. Lau (*Astronomische Nachrichten*, No. 4900). The scale in this case is white=0, yellow=5, and red=10. The influence of atmospheric absorption and the effect of magnitude have been examined, and a catalogue showing the colours of more than 700 of the brighter stars is given.

AN AUSTRALIAN CHEMICAL INSTITUTE.

AN Australian Chemical Institute has been formed with its headquarters in Sydney, and branches in every State of the Commonwealth. The provincial committees include the professors and other teachers of chemistry in the universities and most of the professional chemists in the several States. The institute has been framed on much the same lines as the Institute of Chemistry for Great Britain and Ireland. The objects set forth are:—(1) To raise the status and advance the interests of the profession of chemistry; (2) to promote the usefulness and efficiency of persons practising the same; (3) to afford facilities for the better education and examination of persons desirous of qualifying as technical analysts and chemical advisers; (4) to obtain power to grant legally recognised certificates of competency. Persons eligible for membership must possess certain qualifications, such as the degree of a recognised British university where they have studied chemistry for not fewer than three years, or an approved diploma in some branch of chemistry granted by an approved technical college or school of mines (no mention is made of the length of study required from such), or be fellows or associates of the Institute of Chemistry of Great Britain and Ireland, or who have satisfied examiners appointed by the council that they have attained a necessary standard of chemical education; other persons may be admitted by the council without examination for special reasons on the recommendation of the committee of a branch.

The council does not intend to hold any examination for admission before January, 1918, but lecturers or teachers of chemistry at an Australian university, technical college, or school of mines, or approved secondary school, chemists who are in charge of a Government laboratory, or have been in charge of a laboratory attached to a commercial or industrial establishment for three years, chemists or analysts who have been in practice for three years, and certain others will be eligible for membership without examination before that date. Chemists who have been absent from Australia on war service may be admitted without examination after January 1, 1918, at the discretion of the council. One of the stated duties of the council is to take any steps that may appear to be advisable to improve the rate of remuneration of chemists in private practice or in the employment of

the Federal or State Governments or commercial establishments; another duty is to appoint committees for fixing standard methods of chemical analysis, for the publication of memoirs or bulletins, and for the standardisation of fees for professional work. It is intended to apply for a charter for the institute. A number of the professorial and professional chemists in Australia are fellows of the Institute of Chemistry of Great Britain and Ireland, and probably one of the principal reasons for forming a similar institute in Australia is in consequence of the difficulties connected with the holding of the former's examinations in Australia, due to the great distance and other causes now increased by the war.

CHILD-STUDY AND EDUCATION.[1]

THE special merit of the "Memorandum on the Educational Principles upon which should be based all Future School Reform" is that it dwells on the need for basing education upon a true theory of child-nature. It consists of an introduction by Prof. Adams, five sections written by "experts," and a series of "recommendations." All who are interested in educational progress should urge these "recommendations" on education authorities.

From the title one might suppose that these "principles" have been stated once for all by the council of the society. Fortunately this is not so. In the recommendations we find two "principles" only, viz. that reform must be based on knowledge, and that knowledge must be obtained through real investigation.

The suggestions as to how additional data are to be sought are both wise and practical, though there is much that is unscientific and altogether out of place in sections 3 and 4, which, as Prof. Adams puts it, "have the special merit of correlating age and advancement," and he adds that teachers will read with some eagerness what the experts have to say on this. But, in this memorandum, "merit" should be replaced by "*de*merit." If there were such a correlation, the only way to improve education would be to extend the period of pupilage. The basis of the memorandum is that there is no such correlation—that with a truer psychology, intelligence and knowledge will be greater at a given age. Naturally, then, no trace of these excrescent sections appears in the "recommendations."

The memorandum is called for. There is considerable evidence that, under the influence of traditional beliefs, we are to-day perpetuating mistakes in education no less serious than those in medicine before Pasteur's discoveries overthrew the traditional wisdom of physicians. One instance may here be given. The writer knows of a boy, three years eight months old, who, never having *lessons*, has been brought up in an environment providing as free and full opportunity for mental as for physical development. At two he did the Montessori exercises with ease and accuracy when presented to him, and did not care to repeat them more than once or twice. At two and a half his guardian wrote:—"He has a scrupulous sense of order, great carefulness, and a deft handling of everything he touches. He is allowed to explore and handle everything he wishes, even the most delicate articles, merely enjoining on him to be very careful," and more in the same strain, and he scarcely ever broke anything. Later, at three and a half:—"Whenever he sees anything new to him, he at once wants to know its name and all about it; he is quick to observe the different leaf buds on the trees, and can distinguish and name many trees by their buds alone; sometimes he will bring in a little branch, run to our 'Nature-book,' and compare it with the pictures, finding out which it is for himself. He is also full of interest in birds and knows twenty different kinds by name," and so on. This child has been remarkably free from ailments, as have been all the other children whom the writer can trace who have been brought up in this way, being allowed the free choice of mental as well as of physical occupations; treated always as intelligent, but never forced to mental exertion. And we find among the products of this method great *old* men such as Lord Kelvin.

This is the method indicated by Nature. The brain of the very young child is proportionately far more developed than any other part of his physical system; why should we assume that it is the part to be given the least opportunity for early growth and development through the exercise of the activities peculiar to it? As in such matters experience is the only guide, the writer would be very glad if those who have trustworthy data on the question of early education would communicate with him at Trinity College, Dublin.

E. P. CULVERWELL.

[1] Published by the Child-Study Society, 90 Buckingham Palace Road, London, S.W.1. Price 4*d*. post free.

THE HYDRAULIC RESOURCES OF FRANCE.

IN view of the partial dependence of France on other sources for her coal supplies, the question of utilising water-power becomes an increasingly vital factor in her economic development. Considerable interest therefore attaches to an article appearing in *La Nature* for June 23, which incidentally furnishes also a comparison with the resources of other countries in this respect. Various computations have been made as regards France; one made in 1911 places her resources at 9,200,000 horse-power of water-power available for a minimum of 180 days in the year. This is against Norway's 7,500,000 h.p., Sweden's 6,750,000 h.p., Austria-Hungary's 6,450,000 h.p., Italy's 5,500,000 h.p., Spain's 5,000,000 h.p., Switzerland's 1,500,000 h.p., Germany's 1,425,500 h.p., and Great Britain's 396,000 h.p. In this connection Norway's available supply is 36·60 h.p. per square kilometre of area, that of Sweden 20 h.p., of Austria-Hungary 19·46 h.p., Spain and Italy 10 h.p. each, England and Germany 2 to 3 h.p. each. France's resources, according to recent estimates, are about 25 h.p. for the same area. The quantity of water available in the Alpine regions alone of France represents about 4,000,000 h.p.

The value of the water-power resources of France has long been recognised, and while she has utilised them to a greater extent than certain other European countries have theirs, about nine-tenths are still unharnessed. Germany, on the other hand, though rich in coal, has utilised about 31 per cent. of her available supply of water-power.

Contrary to expectations, the war, instead of relaxing attempts to employ water for power-raising in France, has greatly stimulated activity in this direction, in spite of dearth of labour and materials. The article gives interesting details of plants already completed or in course of erection.

Much is hoped for by utilising barrage water at high pressures; especially is this the case in respect of the electrometallurgical and electrochemical industries, which are sure to develop when new works come into existence and more experience is gained.

France's annual requirements of coal are estimated in the near future to be thirty million tons per annum, and as prices are likely to increase considerably, the author's plea for the extended applications of water-power is justifiable. He asks what this 9,000,000 h.p. of available "white coal" represents in terms of

ordinary coal. According to calculations which were made at one time by M. Loucher, each horse-power-hour produced on a locomotive is equivalent to a consumption of 2·5 kilos. of coal. Consequently, the water-power yet to be utilised represents 20,000 tons of coal per hour, or, say, 180,000,000 tons per annum.

The author admits, of course, that certain industries cannot dispense with coal, but suggests the use of hydro-electric power wherever applicable. Railways such as the Midi, the Paris-Lyons-Mediterranean, and the greater part of the Orleans should be electrified. Large cities, like Paris, should follow the example of Lyons. He pictures the advantages to Parisians in respect of suburban transit, their industries, and lighting, had the Rhone barrage at Genissiat been completed before the war.

Certain trades, as has been said, can dispense with coal if electric power is available, such as the textile, chemical, and paper trades. Metallurgy, glass-making, pottery, and zinc refining use up enormous quantities of coal. But this state of things will not always persist; synthetic pig-iron will one day replace the present commodity; the electrometallurgy of zinc is now a practical proposition; the ceramic art is capable of modernisation; and electric bakeries are not merely utopian.

In addition to being a source of heat, "white coal" is also a source of cold; low temperatures are necessary for obtaining synthetic nitrogenous products, cyanamide, electrolytic potassium and permanganate—substances which could, under the new *régime*, be produced cheaply in France. Further, "white coal" would help agriculture, not only by providing manures, nitrates, and cyanamides, but for driving tractors, lighting farms, irrigating pasture land, working pumps, ventilators, drying plants, separators—and in a host of other ways.

E. S. HODGSON.

ETHNOLOGICAL WORK IN QUEENSLAND.

IN vol. xxix., part i., of the Proceedings of the Royal Society of Queensland, the president, Dr. R. Hamlyn Harris, under the title of "Some Anthropological Considerations of Queensland and the History of its Ethnography," supplies an interesting review, with a full bibliography, of the ethnological work which has been done in the State. In 1914, at Talgai, on the Darling Downs, a skull was found in a river deposit in which remains of Diprotodon and other extinct marsupials had already been discovered. The geological evidence is not quite satisfactory, but there are some reasons for believing that it belongs to the Pliocene period. Dr. G. A. Smith, of Sydney University, believes that it is the skull of a young Proto-Australian which is practically indistinguishable from that of a present-day native. It shows a very primitive facial skeleton, the jaw and teeth of which display remarkable features, even more primitive than those hitherto described in any human skull, except in Piltdown. In particular are noticeable the great squareness and enormous size of the palate and teeth, and the semi-anthropoid nature of the articulation of the upper canines with their mandibular opponents. In the same neighbourhood, in 1906, a couple of rough implements of Palæolithic type were unearthed.

In the same paper Dr. Hamlyn Harris discusses some other interesting questions. The principal centre of mummification in Queensland was on the east coast, around Cairns and the Johnstone river, extending in a southerly direction. This singularly restricted area suggests that the habit of mummification was not introduced from Malaysia, nor *viâ* Cape York, but that it was brought from the far islands of Torres Straits by natives who were carried on to the north-eastern coast of Queensland, more or less by chance. This in some measure corroborates the views of Prof. Elliot Smith, who suggests the Cape York Peninsula, *viâ* Torres Straits, as the hypothetical route in the migrations of the culture bearers who were responsible for the diffusion of the "heliolithic culture complex." Dr. Hamlyn Harris suggests that in geological times Australia was in land connection with Asia, not only with New Guinea, but probably also with Timor, and certain Queensland birds and animals are more closely allied to Asiatic than to Papuan species. He fully accepts the conclusion of Dr. Rivers and Prof. Elliot Smith that the oceanic cultures have been mainly derived from contact with other races. Mornington Island, on the Gulf of Carpentaria, preserves an almost unique example of Australian aboriginal culture which has not been affected by foreign influences.

THE SOILS OF HAWAII.

THE island of Hawaii is the largest of the group of Sandwich Islands, which were formally annexed to the United States in 1898. It is mountainous and volcanic, and the soil is highly productive; sugar and pineapples are the staple industries, but coffee, honey, hides, sisal, bananas, rice, wool, cotton, and rubber are also exported. As usual with American possessions, a strong agricultural experiment station has been developed; in this particular case the work was done under the auspices of the Sugar Planters' Association. The director, Dr. H. P. Agee, and the staff have carried out some excellent investigations on the problems connected with the local agriculture. The latest publication is by the chemist, Mr. P. S. Burgess, and deals with the soils of the island. These are of special interest because they are of volcanic origin, and are situated in a different climatic zone from our own, so that they differ in many respects from the ordinary soils of Great Britain or America, especially in their large content of oxides of iron and aluminium, and their small content of silica. Thus the average of a number of analyses is:—

		Fe_2O_3	Al_2O_3	SiO_2	
Hawaiian soils	...	28·0	20·7	32·6	per cent.
American soils	...	3·8	5·1	85·5	,, ,,

The soils to which we are accustomed have been formed in such a way that their chief constituent is insoluble silica or silicates; the Hawaiian soils, on the other hand, contain large quantities of iron and aluminium oxides; they are known as laterites; other instances occur in Java. This difference in composition especially affects the finest grade of material, the clay, which in the Hawaiian soils consists mainly of iron and aluminium oxides, while in the soils of temperate zones it consists chiefly of silicates. In consequence the behaviour to water is profoundly modified, and the hygroscopic coefficients and other constants are quite different from those obtained on normal soils.

Bacteriological investigations have been put in hand, but, as usual with American stations, the work is mainly concerned with the amount of decomposition effected by the organisms, and not with the organisms themselves. The results suggest that a detailed comparison of typical organisms would be of considerable interest.

So far as we know, the Hawaiian Sugar Planters' Experiment Station is the only station issuing English bulletins which has the opportunity of fully investigating laterite soils. It has, therefore, an unusually good range of problems. There can be little doubt that a detailed comparison of these soils with typical soils of the eastern seaboard of the United States would throw much light on the problems of soil chemistry and soil physics.

E. J. R.

EXPERIMENTAL PHONETICS AND ITS UTILITY TO THE LINGUIST.[1]

THE art of speaking a foreign language demands (among other things) an ability to perform all kinds of difficult movements with the tongue and other parts of the speech-mechanism. Such ability may be acquired by the learner, if he is provided with precise instructions as to what he must do. It is the function of the phonetician to supply these instructions.

Instructions as to how to pronounce must, in order

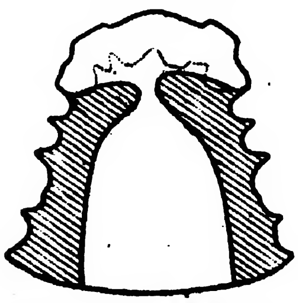

FIG. 1.—Palatogram of *s*.

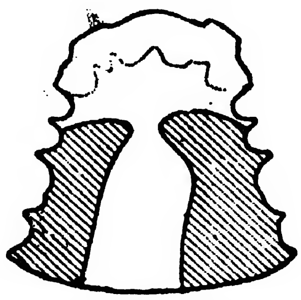

FIG. 2.—Palatogram of the English sound of *sh*.

to be efficacious, be based on accurate analysis of the pronunciation. Many of the facts of pronunciation can be ascertained by direct observation (by auditive, visual, tactile, and muscular sensation) on the part of those who have a specially trained ear and a highly developed control over their vocal organs. These methods are extremely important, and no satisfactory analysis of a language can be made without them. Other methods, however, may be used to supplement these, namely, mechanical analysis by means of a specially designed apparatus. Analysis of this kind constitutes the branch of phonetics known as experimental phonetics. It is with these mechanical aids to analysis that we are here concerned.

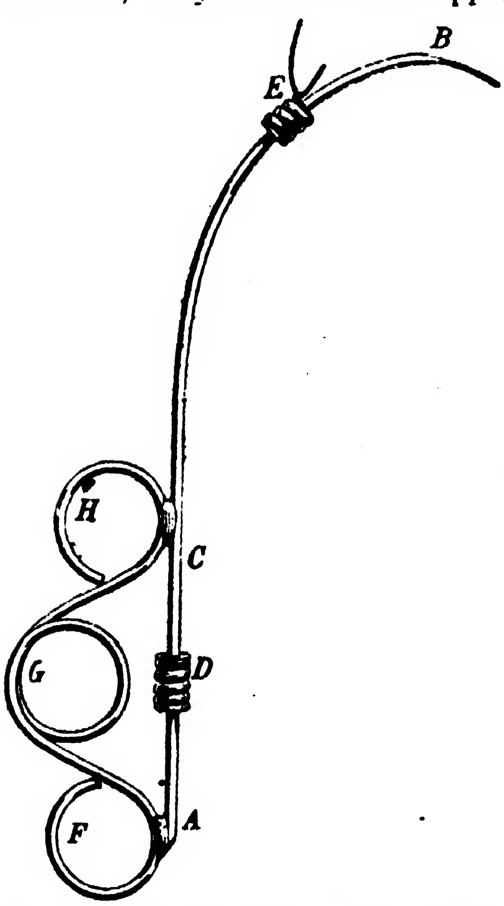

FIG. 3.—Atkinson's mouth-measurer. ACB, tube; D, handle of wire; E, tooth-stop; FGH, handle.

It will be well to give first a few examples to show how information regarding *tongue-positions* may be ascertained experimentally.

One way of getting information is that known as *palatography*. It consists in using a special kind of artificial palate, in order to find out what parts of the roof of the mouth are touched by the tongue in the production of different speech-sounds.

The requirements of this special type of artificial palate are that it should be very thin, should fit very accurately, should be dark coloured, and should cover the whole of the hard palate, alveolars, and the underside of the upper front teeth. Such palates may be made of vulcanite, or metal, or other substances.

When the palate is to be used, it is dusted over with powdered chalk; it is then inserted into the mouth; the sound to be studied is pronounced, and the palate is taken out. It will be found that the chalk has been removed by the tongue at every point which the tongue has touched in articulating the sound. So the areas touched by the tongue appear dark, while the parts of the palate which are not touched remain white.

The shapes of the dark areas may be recorded by photography if desired, but it is generally sufficiently accurate, and a good deal more convenient, simply to copy the dark areas on to a previously prepared outline diagram of the palate. (The result is, of course, a projection of the true shape.) The finished diagrams are called *palatograms*. Palatograms will be found to corroborate observations of tongue-positions made by other methods.

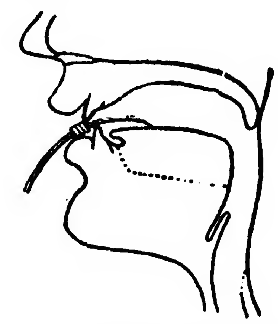

FIG. 4.—Atkinson's mouth-measurer in position.

Figs. 1 and 2 are examples of palatograms.

We will now turn to methods of ascertaining the *shapes* assumed by the tongue in the articulation of speech-sounds, and more particularly the shapes of a section of the tongue down the mesial line, and their relations to the centre-line of the palate.

One method of ascertaining these shapes was invented by Dr. E. A. Meyer, of Stockholm. It consists in using an artificial palate down the middle line of which are fixed some lead threads which hang vertically. These threads are of such a thickness that the pressure from the tongue will bend them when a speech-sound is produced; but they are strong enough to remain in the position into which they are pushed. So that if the palate is taken out of the mouth after pronouncing a speech-sound, the lead wires show the

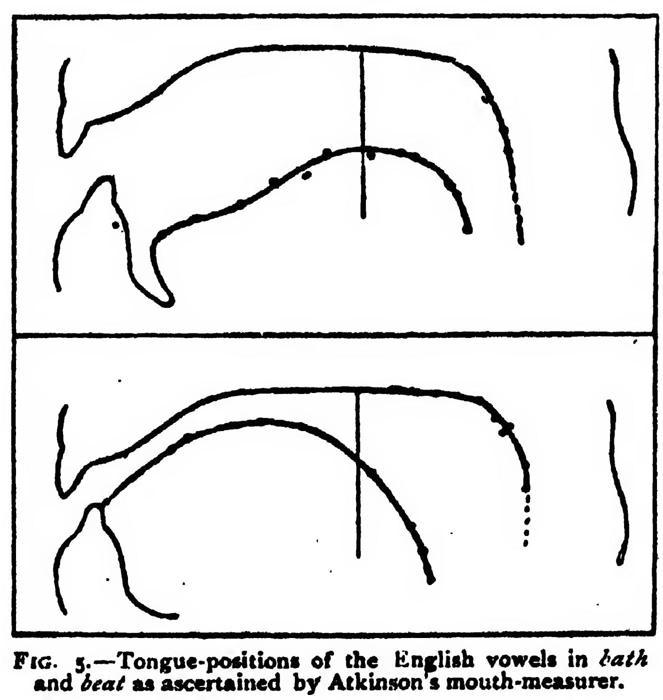

FIG. 5.—Tongue-positions of the English vowels in *bath* and *beat* as ascertained by Atkinson's mouth-measurer.

outline of the tongue-position compared with that of the palate. There is a means of transferring these outlines to paper.

A second apparatus for obtaining similar results is the "mouth-measurer" invented by H. W. Atkinson.[2] There is a tube of the shape ACB, shown in Fig. 3, and inside the tube is a wire which can be pushed along (by means of the handle D) and made to project to different lengths from the end of the tube. A projecting piece of metal, called a "tooth-stop" (E), is

[1] Abridged from a discourse delivered at the Royal Institution on February 9 by Mr. Daniel Jones.

[2] Obtainable from Mr. H. W. Atkinson, West View, Eastbury Avenue, Northwood, Middlesex. (Price 5s. 6d. for set of two mouth-measurers, with accessories.)

attached to the tube; it can be fixed at various points. FGH is a wire handle.

To use the instrument, it is placed in the mouth either in the manner shown in Fig. 4, or else so that the tube is in contact with the teeth at the tooth-stop and also in contact with some point of the palate (the position of the apparatus depending on the nature of the sound to be analysed). The wire is then pushed along until the end of it is felt to touch the tongue. The instrument is withdrawn and applied to a previously prepared diagram of the shape of the observer's palate. The position of the end of the wire is then marked on the paper.

FIG. 6.—X-ray photograph of cardinal vowel *i* (as in French).

FIG. 7.—X-ray photograph of cardinal *a*.

FIG. 8.—X-ray photograph of cardinal *u*.

Further observations are then taken with the tooth-stop fixed at other points. In this way the positions of other points of the surface of the tongue are ascertained. In the end we get on our paper a series of, say, ten or more points which show with fair accuracy the shape of the most important part of the tongue.

Fig. 5 shows specimens of results obtained by this means. They were prepared by Mr. Atkinson, and are reproduced here by his kind permission.

A third method of obtaining sectional diagrams of tongue-positions is X-ray photography. In order to get good results by this process it is necessary to make use of some opaque substance to show the outline of the tongue. The plan which has given the most successful results is to place on the tongue a little chain of small lead plates. (This plan was originally devised by Dr. E. A. Meyer.)

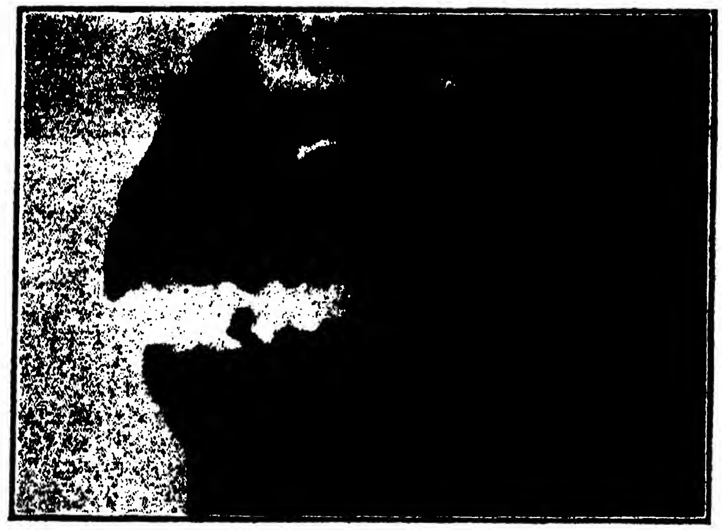

FIG. 9.—X-ray photograph of the sound *k* as in *cave*.

Figs. 6 to 10 are photographs of this description taken by Dr. H. Trevelyan George, of St. Bartholomew's Hospital, who has displayed much ingenuity and patience in getting over the numerous difficulties which present themselves in the course of work of this nature.

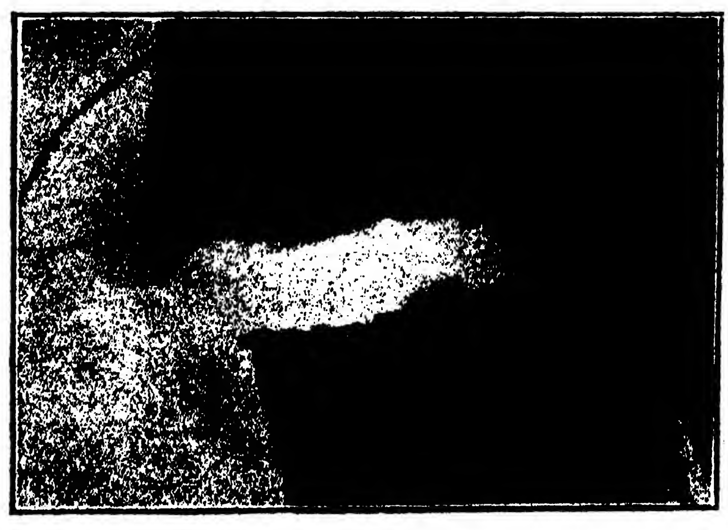

FIG. 10.—X-ray photograph of Welsh *o*, as in *ton*, "wave." Said by Mr. Stephen Jones, Assistant for Experimental Phonetics at University College, London. Tongue-position shown by lower chain. The upper chain passes through the nose, and shows the shape of the upper side of the soft palate.

Another element of speech which can be successfully studied by the methods of experimental phonetics is the vibration of the vocal chords. Some speech-sounds (*e.g.* normal *v* or *z*) are accompanied by vibration of the vocal chords, others (e.g. *f*, *s*) are not; others, again, are accompanied by vibration during a part of their length. It is important for linguistic purposes to ascertain with accuracy the precise points where vibration of the vocal chords begins and ends in connected speech.

FIG. 11.—Mouth-tracings of (A) fully aspirated *p*; (B) partially aspirated *p*; (C) unaspirated *p*; (D) unvoiced *b*; and (E) fully voiced *b*—each followed by the vowel *a*.

There are several ways of recording mechanically the presence or absence of voice. The method which gives the most satisfactory results from the point of view of the linguist consists in using a kymograph fitted with one or more tambours of Marey's model. This method was described in NATURE for June 9 last, and readers are referred to that article for details.

Figs. 11, 12, and 13 are some additional kymographic tracings illustrating linguistic phenomena.

The above examples show to what extent experimental phonetics may be useful to the language learner. It furnishes him with much of the information he wants in regard to pronunciation. The practical linguist should make these ascertained facts the basis of his study of the pronunciation of the language he is learning. He will be able to infer from them how he must proceed in order to get his own organs of speech to perform the movements required by the foreign language.

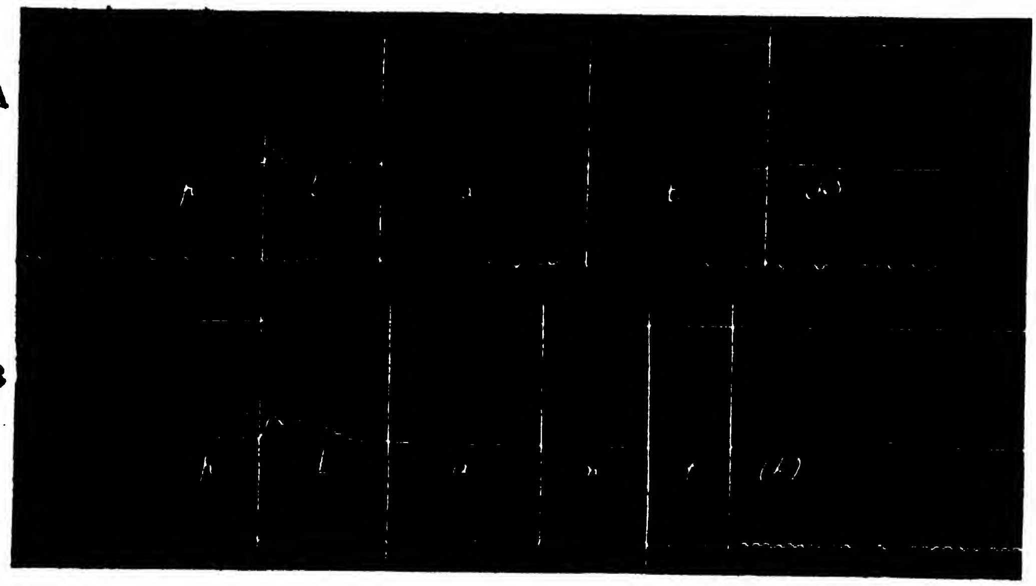

FIG. 12.—Simultaneous mouth- and nose-tracings of (A) French *plante* (female voice); (B) English *plant* (male voice). Note the absence of *n* in French.

In conclusion, it may be as well to point out that as these scientific methods of analysis are useful to the linguist, so also the accomplishments of the linguist are sometimes found to have their uses to the man of science. Thus it is possible by means of a speech process to demonstrate in a remarkable way the existence of harmonics in a musical note—to show, for instance, that if the note *c* is sung, there is sounding simultaneously the well-known series of harmonics, *c′*, *g′*, *c″*, *e″*, *g″*, etc. This fact is made evident by putting the mouth into a series of positions which will act as resonators and reinforce different harmonics one after the other. If only one position is taken up by the mouth, some harmonic or other is necessarily reinforced, though it is extremely difficult to detect which. But by making rapid changes from one mouth-position to another, the successive harmonics become clearly audible *by contrast*. The speech-movement which makes these harmonics come out most clearly is to start by holding the tongue in the position of the English sound of *ng* and rounding the lips and gradually separating them. At close quarters the effect is that of an arpeggio played on a tiny harp. If the voice-note is changed, the same arpeggio is heard in a different key.

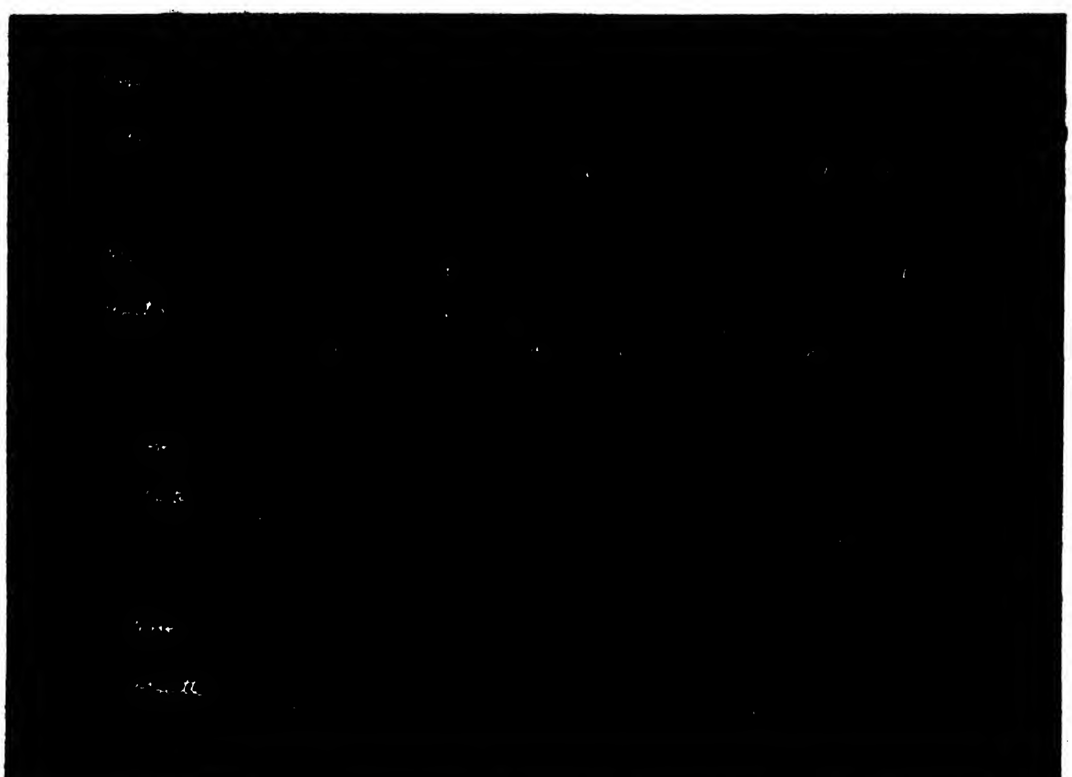

FIG. 13.—Simultaneous mouth- and nose-tracings of (A) *side*; (B) *sign*; (C) *nine*; and (D) *nine* pronounced in cockney-fashion. Note the difference in the nose-tracings. The words were all said on the monotone B♭ this being the note to which the nose-tambour happened to respond best.

This phonetic experiment may or may not prove to have some direct value in the direction of elucidating problems of sound-quality, but at any rate it is useful as a practical demonstration of the presence of harmonics in a musical sound.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—During the session 1917–18 Prof. John Adams, professor of education in the University, will give two courses of lectures which will be open without fee to teachers. The first course will begin on October 13, and will be on "Collective Psychology." The second course will be on "Attention," and will begin on January 19, 1918. A course of lectures on "The Practical Applications of the Study of Weather" will be given at the Meteorological Office, South Kensington, by Sir Napier Shaw, on Fridays during the second term, beginning on January 25. The fortnightly meetings of the Meteorological Office for the discussion of important contributions to current meteorology in Colonial or foreign journals will be resumed at 5 p.m. on Monday, October 22. The lectures are addressed to advanced students of the University and to others interested in the subject. Admission is free, by ticket to be obtained on application at the Meteorological Office. The following are among the public lectures in Imperial studies arranged for the first term of the session 1917–18:—*At University College*: October 8, Types of Climate in the Empire, Prof. L. W. Lyde; October 18, The Effect of the War on Municipal Engineering and Public Health, H. Percy Boulnois; October 22, Phonetics and its Value from the Imperial Standpoint, D. Jones; October 31, Scientific Methods of Language Study and their Importance to the Empire, Harold E. Palmer; six Newmarch lectures on Statistics, Economics, and some Problems of the Day, Henry Higgs, beginning on November 7. *At King's College*: October 31, The Problems of the Pacific, Basil H. Thomson; November 14, The Development of Tropical Africa (the name of the lecturer will be announced later). *At the London School of Economics*: October 12, The Commercial Geography of the Empire, Prof. A. W. Kirkaldy; October 19, Coal, Arthur F. Pease; November 2, Mineral Oil, Prof. J. S. S. Brame; November 16, The Rarer Key Minerals, Sydney J. Johnstone. Arrangements as to further lectures will be announced later. The subjects dealt with will be iron and manganese ores, artificial manures, fodder, timber, wood-pulp and paper-making materials, fibres, tea, meat, leather and tanning materials.

A message from the New York correspondent of the *Times* states that the trustees of Columbia University have expelled Prof. H. J. L. Dana and Prof. J. McKeen Cattell, professor of psychology, whose disloyal attitude was "doing grave injustice" to the institution. Dr. Murray Butler pointed out, in a statement recently made by him, that before the entrance of the United States into the war complete freedom of expression could not be denied to members of faculty, but after the declaration of war by Congress it became the duty of everyone either on the rolls of the faculty or on the rolls of students to support the loyal enforcement of all the laws of the United States.

A meeting will be held in the theatre of the Institution of Civil Engineers on October 25, at 3.30 p.m., for the purpose of considering the establishment of a central organisation for improvement in, and better co-ordination of, engineering training and the appointment of a representative committee of engineering and educational interests to initiate action. Sir Maurice Fitzmaurice, C.M.G., president of the Institution of Civil Engineers, will preside, and representative engineers and educationists from all branches of these professions have signified their intention to be present. Those interested are requested to communicate with Mr. A. P. M. Fleming, British Westinghouse Co., Trafford Park, Manchester, or Mr. A. E. Berriman, chief engineer, Daimler Co., Coventry, who are acting as honorary organisers for the committee responsible for arranging this meeting.

The summer course of lectures given by Prof. Conrady, on the designing and computing of telescope systems, in connection with the newly formed department of technical optics at the Imperial College of Science and Technology, South Kensington, has been a great success. Sixty-six students enrolled, of which number no fewer than forty-two came direct from the workshop. This result is especially gratifying when it is remembered that the course was an entirely new experiment, as it constituted the first attempt, it is believed, in the history of optics to deal with the subject of designing and computing in a course of public lectures. At an early date—of which due notice will be given—further courses of lectures will be given on optical designing by Prof. Conrady, and on "The Construction, Theory, and Use of Optical Measuring Instruments" by Mr. L. C. Martin.

The number of universities and colleges in the British Isles providing training for medical men and professional chemists is now large enough to make many parents and guardians feel the need for guidance in making a selection, and they will welcome the special educational issues recently published by the *Lancet* (August 25), the *British Medical Journal* (September 8), and the *Chemical News* (September 7). In each case detailed information is given of the courses of study, the staffs, fees, and so on, at each important college, and in the case of our medical contemporaries guidance is provided as to the facilities for practical study at the more important hospitals. Descriptive articles by writers of experience also explain the steps necessary for students who desire to become practising medical men or chemists. From the *British Medical Journal* we gather that the effects of the war upon the medical profession, and especially upon medical education, have been profound and far-reaching. Last year the Army and Navy together were employing upwards of 12,000 medical men, and this number must now be much greater. Before the war some 3300 medical officers were accredited to the Services year by year. As regards the number of medical students, between the years 1910 and 1914 the annual entry of first-year medical students averaged some 1440. Since the war the number of these entries has increased by several hundreds a year. In May, 1916, the whole number of medical students was 6103, including 1379 women; in January, 1917, the whole number was 6682, including 1735 women. The third-year students, from whom most of the newly qualified practitioners of 1919 will come, numbered in January last only 572 men and 261 women. It is now clear that certainly in 1918 and 1919 a serious shortage of newly qualified medical practitioners must be looked for, though an increase may be expected in 1920 and 1921.

Calendars and prospectuses continue to reach us from colleges and technical institutions in different parts of the country, and the particulars they provide of the courses of study which have been arranged for the forthcoming session show that the authorities have spared no pains to meet the need for scientific and technical education in the districts for which they are responsible. The character of the work carried on at Birkbeck College, London, is indicated by the fact that thirty members of the staff are recognised teachers of the University of London, sixty-eight students passed University examinations during last session, of whom twenty-three graduated in arts and science, and four war degrees also were conferred. The usefulness of the college is much curtailed by its limited accommodation. The pressing need is for in-

creased space, and it may be hoped that ere long the governing body will be provided with sufficient funds to make it possible to secure college buildings worthy of the excellent work which has been accomplished here. The work at Armstrong College, Newcastle-upon-Tyne, is being done under difficulties. The college buildings have been in the occupation of the War Office since August, 1914, and the various departments are housed temporarily in different buildings. Pass and honours degrees are awarded, on the conditions laid down in the prospectus, in both pure and applied science. Candidates who have qualified for the pass degree of B.Sc. may proceed, with the approval of the Board of the Faculty of Science, with the course of study in the honours school, and in applied science can take up one of the following subjects:—Agriculture, mechanical, marine, civil, or electrical engineering, naval architecture, mining, metallurgy. The Edinburgh and East of Scotland College of Agriculture, which was founded in 1901 to provide for agricultural education and research in the central and south-eastern counties of Scotland, has arranged classes in conjunction with the science faculty of Edinburgh University, constituting a full course of theoretical and practical teaching in agriculture and the allied sciences. The services of the college staff are at the disposal of farmers who are investigating new conditions or special problems arising out of farming operations. Full particulars can be obtained from the offices of the college, 13 George Square, Edinburgh.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 17.—M. Camille Jordan in the chair.—A. **Lacroix**: The peridotites of the Pyrenees and the other intrusive non-felspathic rocks which accompany them. Descriptions of the lherzolites, cortlandites, ariegites, and hornblendites, together with complete chemical analyses of twenty-one specimens.—M. **Petrovitch**: A new method of numerical evaluation of the coefficients of series.—C. **Benediks**: A new thermo-electric effect. The author's results are contrary to the law of Magnus, and show that in a homogeneous metallic circuit an asymmetrical distribution of temperature may give rise to an electromotive force.—J. B. **Tauleigne** and G. **Mazo**: The method of monocular stereoscopy especially applicable to radiography.—M. **Mazérès**: A new method of extraction with the radioscopic screen: the method of concordances.—D. **Keilin**: A new Nematode, *Aproctonema entomophagum*. The new species was found as a parasite in the larvæ of *Sciara pullula*.—E. **Roubaud**: Can French Anopheles transmit malaria in non-marshy regions? *A. maculipennis* from the Paris district has been proved to be capable of transmitting malaria (*Plasmodium vivax* and *P. praecox*), and do not possess any special refractory properties. Since malarial cases are being introduced from the Eastern front, it is obvious that special precautions against the spread of the disease are indicated.—A. **Laveran**: Remarks on the preceding communication of M. Roubaud. An account of the measures which have been taken in France to prevent the spread of malaria from infected soldiers.

BOOKS RECEIVED.

Survey of India. General Report, 1915–16. From October 1, 1915, to September 30, 1916. (Calcutta.) 2*s*. 8*d*.

Memoirs of the Geological Survey of India. Vol. xlii., part 2. Vol. xlv., part 1. (Calcutta.) Each 4*s*.

Composition and Nutritive Value of Feeding Stuffs. By Prof. T. B. Wood. (Cambridge: At the University Press.) 1*s*. net.

Memoirs of the Geological Survey, England and Wales. Explanation of Sheet 329. The Geology of the Country around Bournemouth. Second edition. By H. J. O. White. Pp. vi+79. With separate map. (London: H.M.S.O.) 2*s*. net.

The Discovery of America, 1492–1584. Edited by P. F. Alexander. Pp. xviii+212. (Cambridge: At the University Press.) 3*s*. net.

Insetti delle Case e dell' Uomo e Malattie che Diffondono. By Prof. A. Berlese. Pp. xii+293. (Milano: U. Hoepli.) [illegible]o lire.

Celestial Objects for Common Telescopes. By the Rev. T. W. Webb. Sixth edition, thoroughly revised by the Rev. T. E. Espin. Two vols. Vol. i., pp. xx+253; vol. ii., pp. viii+320. (London: Longmans and Co.) Each 7*s*. 6*d*. net.

The Elements of Refrigeration. By Prof. A. M. Greene, jun. Pp. vi+472. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 18*s*. 6*d*. net.

Alternating-Current Electricity and its Applications to Industry. Second Course. By W. H. Timbie and Prof. H. H. Higbie. Pp. ix+729. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13*s*. 6*d*. net.

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THURSDAY, OCTOBER 11, 1917.

MARSHALL'S EXPLOSIVES."

Explosives. By A. Marshall. Second edition. Vol. ii., *Properties and Tests*. Pp. ix+411–795. (London: J. and A. Churchill, 1917.) Price 3*l*. 3*s*. net the two vols.

THIS second volume of Mr. Marshall's treatise is divided into four parts, dealing respectively with the Properties of Explosives, Special Explosives, Stability, and the Analysis of Materials. There has been some re-arrangement of the matter since the issue of the first edition; for example, coal-mining explosives are comprehensively dealt with in a special chapter, and another chapter is devoted to naval and military explosives.

There has been considerable extension of the section devoted to the power of explosives, both on the theoretical and the practical side. The French modification of the well-known Trauzl test is introduced, and the earth test, in which the explosive is buried in soil which has been undisturbed for years, and the enlargement of the cavity after firing measured and its capacity determined. Reference is made also to a test in concrete blocks.

In dealing with initiators of explosion, which began with flame and developed through the flint and steel to the use of fulminate of mercury compositions, we have the latest development for detonating high explosives referred to, namely, the use of compound detonators where fulminate provides the first step, and its action communicated first to such nitro-aromatic explosives as trotyl (trinitrotoluene) or tetryl (tetranitromethylaniline), which, in turn, bring about the detonation of the main charge. Other alternatives to the fulminates are the azides. In all these highly sensitive substances there appears to exist a state of great strain in the crystals; this is confirmed by their strong double refraction, and the larger the crystals the higher their sensitiveness to shock. While the azides are not so "brisant" as the fulminates, by combination with nitro-aromatic explosives very effective results are obtained. Azides have one advantage over fulminates besides less sensitiveness, for fulminate deteriorates on storage, especially if the temperature is high or the atmosphere damp. One per cent. of water renders fulminate useless; lead azide, on the other hand, is much more permanent, and 5 per cent. of moisture has been found to make no perceptible difference in its action. Mr. Marshall quotes extensively data on the quantities of different initiators required for various explosives.

For gelatinised nitroglycerine explosives "renforts," or "boosters," consisting of short brass tubes of a size to fit over the detonator and charged with trotyl, or other explosive of similar type, are employed. For high-explosive shell, where premature detonation must be rendered impossible, or at least most improbable, the use of a powerful sensitive detonator is out of the question, and for picric acid charges picric powder (ammonium picrate and saltpetre) is employed with a suitable detonator, whilst with the more insensitive trotyl the priming charge is sometimes the same explosive in the form of powder or loosely compressed pellets, but more usually tetryl, and we are told that this is one of the chief uses of the latter, which is now manufactured on a considerable scale. There is some repetition in this section, much the same information being given under "Ignition and Detonation" and "Fuses."

The influence of the war is naturally seen in extended space being devoted in the section on naval and military explosives to mines, torpedoes, the various types of shell, grenades, etc. Naturally, the description is only general. Illustrations of the fragmentation of high-explosive and armour-piercing shell are given from the excellent paper by Major E. P. O'Hern which appeared in the Smithsonian Report for 1914.

In the important and excellent section on stability tests the principal additions are to be found in the Abel heat test. On this standard test there have been much discussion and investigation. There can be no doubt as to its great value if due observance is taken of the conditions and procedure. In 1909 a joint committee was appointed representing the Home Office, the Admiralty, the War Office, and the trade, and a first report was issued in 1914, together with a memorandum of instructions, specification of apparatus, etc. With this report at hand, Mr. Marshall has been able to extend considerably on the test.

In the last section, on materials and their analysis, Mr. Marshall has added some useful matter relating to the important question of sampling. A further extension is found in examples of calculation for the revivification of waste acids from nitration plants, an important matter both in manufacturing and in conserving supplies. More space is devoted to the important raw material cotton, including specifications in different countries. Another material the importance of which has increased enormously is ammonium nitrate. To the examination of this body only a few lines were allocated in the first edition, but much more space is now devoted to it, although no reference is to be found to possible organic contamination, which, with the introduction of nitrate from coal carbonisation, is of great importance.

Excellent as the first edition of Mr. Marshall's work was, his second edition places the book amongst the best technical books which have been written. It is by far the most complete exposition on the subject which has appeared, and only on very minor points can the critic find fault with the subject-matter or detect small omissions. One might, however, plead for more systematic nomenclature with adherence to one name for a particular explosive throughout, with mention of alternatives in the section principally devoted to it.

THE CAR AND ITS DESIGN.

Text-book on Motor-car Engineering. By A. Graham Clark. Second edition. Vol. i., *Construction.* Pp. xix+437. (1914.) Vol. ii., *Design.* Pp. xvi+368+21. (1917.) (London: Constable and Co., Ltd.) Price 8*s.* 6*d.* net each vol.

IN these days of science applied to industry, it has become the rule for each branch of trade to have its own standard text-book. It is therefore somewhat curious, the motor industry being the highly organised and scientific business that it is, that it does not possess its own *vade mecum.* Of writers on matters motorish there are enough, although not many, perhaps, with that engineering and scientific training, together with applied knowledge of the subject, which are essential to one who would take the part of professor to the experts. No doubt that is the rub.

For this reason amongst others, we welcome the second edition of Mr. Graham Clark's book, particularly as in this edition it has grown to two volumes, and approaches more nearly the comprehensive text-book than it formerly did. This is not to say that it is likely to be hailed as the standard book of the industry—Mr. Clark knows the industry too well even to pretend that it is—but we can unhesitatingly affirm that it is the best English work on the subject.

The two volumes, aptly named, as they are, "Construction" and "Design," might with equal pertinence have been entitled "Elementary" and "Advanced." They will stand in that relation to the student, notwithstanding the author's intention that they should be readable as separate and individual publications. As is natural, perhaps, only those well acquainted with most of that with which the first volume deals will be able profitably to peruse the second. To those who already possess a fair smattering of mechanical knowledge of the motor-car, and are desirous of converting that, perhaps, superficial acquaintance into technical proficiency, vol. ii. will be invaluable. Broadly speaking, students, apprentices, and junior draughtsmen will profitably acquire and read both volumes. Senior draughtsmen, budding designers, and all those whose knowledge of the construction of a car is more than superficial will find all that they require in the second volume. There are others, too, who, while desirous of possessing a sound knowledge of the mechanism of a car and of the broad principles which underlie its construction, are unlikely ever to be so placed as to need the technical information which the second part of this work provides. They will be sufficiently equipped with vol. i.

The first volume goes right back to the beginning of the subject, so that the reader may come to it with his mind, as regards its subject, a perfect blank; he will still be able to read and digest its contents. Such a one will naturally take advantage of that special feature of its make-up which provides for the skipping of the more difficult paragraphs, marked with an asterisk, on first reading.

The principal portion of the first volume is devoted to detail descriptions of the parts of a car, indicating their position in the chassis, discussing their functions, and finally, in as simple and non-technical a manner as possible, the nature of the stresses which each will have to withstand. In this manner are dealt with in turn the various units which form the anatomy of a car. Twenty full and interesting chapters are thus utilised, including a useful and comprehensive one on lubrication and lubricants, and also a couple of especial interest just now, on petrol and other fuels which may be used in its stead. The remaining four which go to complete the book are apportioned to the steam car and the electric vehicle. An appendix comprising some official examination papers on the subject and various useful tables conclude the volume.

The reading of the second volume will be for the student a far more adventurous affair than the study of the first. The more purely technical side of the subject, hitherto kept discreetly in the background, is now openly portrayed in the full and glaring light of day. In Mr. Clark's hands, however, the prospect ceases to be an alarming one.

The arrangement of the matter is very similar to that of the previous volume. A preliminary chapter on materials of construction is followed by several on the power unit and its details. The other parts of the chassis then receive attention in turn.

A method of treatment appears to have been standardised, and each component is treated in a way which should prove particularly helpful to the student. It varies, of course, to some extent according to the nature of the part under consideration, but the difference is one of detail rather than of principle. A brief opening paragraph deals with the materials which are commonly used for the construction of the part; this is followed by an outline of the general conditions which govern the design. The nature of the stresses to which the part is subject is next explained, and this is naturally succeeded by a disclosure of the actual methods of determination of the proportions of the part. Wherever advisable the chapter is illustrated by drawings or photographs depicting selected examples of current design. Logically, the author could have referred his readers to the preceding book for these illustrations; their inclusion in the second volume has the desired effect of rendering that volume complete in itself and self-contained.

We are inclined to approve the somewhat unusual disposition of the necessary tables. These, instead of being collected together and placed at the end of the book in the form of an appendix, are inserted in the text as they are required. It might have been better if, instead of indexing them, they had been repeated at the close in the usual manner.

We cannot praise too highly the clearness of diction and simplicity of expression which prevail throughout the work. Were it not for the illustrations, we should have been at some trouble to find any cause for criticism of the work at all. The line blocks are good; they would, however, have been better in many cases if the size had been more carefully selected. On the other hand, the half-tones are, almost without exception, poor in quality, besides sharing with the line blocks the fault, in many examples, of being of unsuitable dimensions. The price limitation may have had someting to do with this marring feature, for the work is undoubtedly cheap as such publications go. A little more discrimination in regard to the scale of the drawings as reproduced, and the preparation of an entirely new set of half-tones from original photographs, would have enhanced the value of the book to a degree which would be out of all proportion to the additional expenditure involved.

OUR BOOKSHELF.

Standard Method of Testing Juvenile Mentality by the Binet-Simon Scale, with the Original Questions, Pictures, and Drawings. By N. J. Melville. With an introduction by Dr. W. Healy. Pp. xi + 142. (Philadelphia and London: J. B. Lippincott Co., 1917.) Price 8*s.* 6*d.* net.

All who have had experience of the Binet-Simon scale, or are acquainted with the literature of the subject, must have felt the difficulties which this valuable little book is intended to counter. The use of any series of mental tests depends so much upon delicate handling in the first place, and upon intelligent interpretation in the second, that the comparison of one set of results with another, even when taken in the gross, is always suspect. The difficulty still exists although the comparison concerns the work of the same inquirer. When we come to the pronouncement on the mentality of a particular child, the chances of error are enormously increased. A physical measurement may be repeated. Accuracy demands that it should be, perhaps many times. Repetition in the case of the Binet-Simon scale is out of the question. The importance of standardising both the way it is used and the interpretation of results cannot, therefore, be exaggerated.

Mr. Melville's handbook explains the fundamental object of the scale and describes the technique of its use with great care and precision. Nothing can make such an instrument "foolproof," though the author points out the pitfalls and warns off the incompetent. Specimen record forms as used in the Philadelphia schools are given, and three supplementary tables provide useful data for assisting final judgment.

The book is in no sense a text-book. It is essentially a guide to practice, and as such may be warmly recommended. It is well printed and strongly bound. A thumb index gives ready access to the pages dealing with the several groups of tests, and there is a good bibliography.

Papers from the Geological Department, Glasgow University. Vol. iii. 1916. (Glasgow: James Maclehose and Sons, 1917.)

This collection of papers, previously published in various journals, records once more the activity of the geological school in the University of Glasgow. Prof. Gregory's address on Henry Darwin Rogers, professor of natural history in the University from 1857 to 1866, brings before the present generation of geologists views on mountain-building and on the relative rapidity of certain tectonic changes which are, indeed, worthy of consideration. Prof. Gregory's valuable review of the economic mineralogy of the war-zones has been already noticed in Nature (vol. xcix., p. 110). With Miss Jean B. Trench, the same author describes Eocene corals from New Guinea, which further support the view that the Malay region was isolated in the early Cainozoic epochs. Montipora, which is here traced back to the Eocene, is thus indicated as originating in the western Pacific, as reaching the Indian Ocean, where it still lives, after the Miocene period, and as arriving on the shores of the Red Sea in Pleistocene times. It is unknown from either Sind or Europe, and the only known fossil species are those of the Pliocene of Borneo and the raised beaches of the Gulf of Suez. Among several papers elucidating local geology, which naturally form the strong point of a collection such as this, we may note Mr. W. R. Smellie's "Igneous Rocks of Bute" (see Nature, vol. xcvii., p. 350) and Mr. Tyrrell's careful additions to our knowledge of the petrography of Arran.

G. A. J. C.

Proceedings of the London Mathematical Society. Second series. Vol. xv. Pp. liii + 454. (London: F. Hodgson, 1916.)

The latest volume of the Proceedings of the London Mathematical Society keeps up to the usual high standard. As regards pure analysis, attention may be directed to Prof. and Mrs. W. H. Young's papers on integrals and derivates, because they deal with fundamentally new notions of the integral calculus, with which every serious mathematician will have to make himself acquainted. Mr. G. H. Hardy contributes a paper of great interest on Dirichlet's divisor problem, and there is a little gem by Mr. T. L. Wren on the two-three birational space transformation, which incidentally gives a new, and we think finally satisfactory, aspect of the double-six configuration. In applied mathematics we have a paper by Prof. Bromwich on normal coordinates, based on the theory of complex integrals; one by Sir J. Larmor on transition from vapour to liquid; and one by Mr. F. B. Pidduck on the motion of ions, discussed by means of an integral equation. We must content ourselves with noting these few papers out of the whole thirty. The volume will doubtless receive the full attention that it deserves.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Modern Range-finder.

PROF BOYS, in his review of Prof. Cheshire's pamphlet on "The Modern Range-finder" in NATURE of September 6, has raised certain questions which may be amplified with advantage.

The application of stereoscopic principles to range-finding is due to Hector Alexander de Grousilliers, who communicated his invention to Messrs. Carl Zeiss, by whom it was elaborated and constructed. As in principle the stereoscopic range-finder is so simple and beautiful it is desirable that the name of the true inventor should be remembered.

Prof. Boys is scarcely correct in stating that the stereoscopic range-finder was proposed by a workman in the Zeiss works. De Grousilliers was a chemist and an engineer in the Continental sense, who lived at Charlottenburg. His British patent, No. 17048, was applied for on September 11, 1893. It is interesting to note that the corresponding German patent, identical in substance, and applied for on January 3, 1893, is issued in the name of Messrs. Carl Zeiss.

As Prof. Boys says, it is fascinating to sweep the scale past more or less distant buildings and see the divisions of the distance scale pass behind or in front of the different objects; but when the observations are made upon objects of known ranges and the results are analysed, the fascination is generally tempered by disappointment.

It has been said with considerable truth that a coincidence observation is a fact, whereas a stereoscopic one is an impression; the former is based upon a self-contained micrometer measurement effected by one eye, while the latter is the result of balancing the effects produced in two separate eyes.

Prof. Boys suggests that for anti-aircraft work the stereoscopic range-finder may be of advantage, owing to its speed of operation, on the assumption, presumably, that an object in any part of the field can be compared with the fixed scale and that accurate direction of the instrument upon the target within the limits of the field is therefore not required. In practice this is not the case. If any reasonable accuracy is to be obtained, the object must be brought close to the appropriate mark or on to the imaginary "plastik" line between two marks; that is to say, the instrument must be both trained and elevated with considerable accuracy. In a coincidence range-finder the image must be brought to the separating line, but it may occupy any position along the length of the line.

In a stereoscopic instrument it is necessary to compare the image with one mark, then with the neighbouring one, and, finally, to locate its position between them. Compared with coincidence, the stereoscopic observation is not more speedy, and therefore not more suitable, for anti-aircraft or similar services, where speed of operation is essential. It involves as careful direction and the accuracy attained is much inferior. Great claims as regards accuracy have been made for stereoscopic range-finders, but these have not been substantiated in practice.

With regard to the question of accuracy, the resolving power of the objective is not one of the limiting factors in the case of coincidence observations. Suppose, for example, that the image is a point circle; then the coincidence operation consists in making the separating line cut the circle approximately diametrically, and in bringing the edges of the upper semicircle into alignment with those of the lower. If now the resolving power of the objective is diminished by decreasing its diameter, the point image will be of larger diameter, but the coincidence operation will not be more difficult than before. Indeed, if the objective diameter is so small that the image is surrounded by distinct diffraction circles, the operation will be facilitated, as such lines constitute ideal coincidence objects. The accuracy depends upon the character of the edges as regards sharpness, and not upon the size of the image of the ideal point.

The coincidence observation figures quoted by Prof. Cheshire are quite ordinary. So far as the unaided eye is concerned, the only limit to resolving power that the writer is aware of is the quality of the definition of the edges of the image at the retina. On natural objects the unaided eye can resolve less than four seconds, and under good conditions of definition an accuracy of two seconds has been obtained with considerable consistency in coincidence observations, but *plus* or *minus* three to four seconds is the more usual practice. JAMES WEIR FRENCH.

Anniesland, Glasgow, September 27.

I AM obliged to Mr. French for correcting me in the matter of the origin of the stereoscopic range-finder. My statement that the idea originated with one of Zeiss's workmen was made on the basis only of my recollection of conversation with Dr. Czapski at the Paris Exhibition in 1900, and it may well be that my recollection is at fault, or possibly that I misunderstood what I was told.

When suggesting that this type of range-finder might have some advantage for anti-aircraft work, the observation I had in mind was sweeping the scale of distance slowly across the object and noticing which division came within and which beyond, and then not more than a rude guess at the proportion between. Such a process I considered would give a very quick but less accurate range than that given by a coincidence instrument, but nevertheless a very useful range in view of the rapid and erratic change of distance. The most aggravating property of the stereoscopic instrument is the transparency that it imposes, even upon buildings, for the more distant scale divisions remain in view as they pass behind them.

C. V. BOYS.

A Plea for the Fuller Utilisation of Coal.

THE important letter from Major Martin (NATURE, August 16) on the above subject involves many considerations, and I would suggest that the following points merit attention:—

(1) It seems probable that after the war there will be a demand for greater home comfort among the poorer paid classes of the community. The supply of very cheap gas for heating and cooking should improve matters greatly.

The cost would be further reduced if arrangements could be made to fit houses with surface-combustion heaters, cookers, and the like (*cf.* Prof. Bone's experiments).

At present it appears to pay many gas companies to supply ordinary gas stoves on specially favourable terms to consumers, so that there seems no reason why surface-combusters should not be supplied from various depôts in different districts. If the gas were distributed at a high pressure, it should be possible to devise some injector arrangement which would obviate the necessity for the use of compressed air, a

supply of which is necessary with the design of surface-combustion apparatus at present in use.

An article on "Coal-gas for Motor Vehicles" (*Times Engineering Supplement*, August 31) gives some figures indicating the effect of compressing coal-gas on its calorific value. It seems that a suitable pressure would probably not exceed 300 lb. per sq. in. If this is too high for use in a house, the gas could be passed through a reducing valve before entering any group of houses.

Briefly, high-pressure gas would be supplied to a group of districts with reducing valves where necessary, just as a high-tension electric supply has transformers placed where required.

(2) As the gas would be supplied in bulk, its composition in any one large district would be uniform, thus facilitating the adjustment of the flameless combusters. In fact, they could be standardised, and sent out ready for use from a central depôt for each large district. The combusters would have to be fool-proof; perhaps by arranging to have adjustments only possible by the use of special tools.

(3) It is obvious that a considerable amount of experimental work is necessary, but the benefits to the community would be so great that it appears worth while starting these experiments as soon as possible. Cheap heating combined with absence of smoke is worth trying for.

(4) It is presumed that the gas would be distributed through weldless steel tubes, so far as possible, above ground for convenience of repair, etc., and along railway tracks where possible. K. C. BROWNING.

31 Boundary Road, St. John's Wood, N.W.8,
September 16.

P.S. (October 7).—A supply of high-pressure gas would be of great value to firms running a service of industrial vehicles, the gas being much cheaper than petrol, and the pressure expediting the filling of the containers.

PROF. BROWNING's letter raises a number of practical points which deserve attention.

My former letter was mainly concerned with the conservation of a great national asset. Prof. Browning deals with the matter in the interest of the gas consumer.

(1) It is impossible to estimate the amount of coal and labour which are wasted every day in keeping up thousands of little domestic fires to boil an occasional kettle, or the saving of coal and labour which a supply of cheap gas would bring about, but they would certainly be very great.

I am sorry not to have kept in touch with Prof. Bone's later experiments, but they are undoubtedly on the right lines. The key to successful heating is radiation, and the amount of heat radiated from a surface increases very much faster than the temperature. If, therefore, the principle of surface-combustion can be applied to domestic heaters, there should be a great gain in comfort, even with a lesser consumption of gas.

It is interesting to contrast the enormous strides which have been made of late years in the efficiency of methods of lighting (both gas and electric) with the comparative stagnation in the field of domestic heating. True, the margin of waste in the latter has not been nearly so great as in the case of the former, but there is still plenty of room for economy, and Prof. Bone's experiments seem to point the way.

(2) It will be convenient to deliver the gas from the coalfields at a high residual pressure, and it will be quite feasible to distribute it at high pressure if this should be considered desirable. It is a much simpler matter to confine gas at a pressure of 220 lb. than electricity at 220 volts, and the pressure of the gas could be utilised to deliver air to the surface-combusters.

(3) A good deal of experimental work will be required to solve the practical problems involved. The enterprise of our great gas companies will doubtless be equal to the occasion.

(4) The question of rights of way will demand very careful consideration. Weldless steel tubes present many advantages, but the question of overground *v.* underground pipe lines can scarcely be settled offhand.

ARTHUR J. MARTIN.

University Hall, Carlyle Square, Chelsea, S.W.3,
September 29.

The Harvest Moon.

THE harvest moon is usually stated to be the full moon nearest in date to the autumnal equinox, and to be distinguished by the peculiarity that for a few successive evenings the retardations of the times of rising are at a minimum.

Now, applying these tests to the full moons of September 1 and 30 of the present year, it will be found that they are inconsistent. The retardations at Greenwich, from August 29 to September 4, are, in minutes, 30, 22, 21, 19, 21, 22, an average of 22½ minutes; but, from September 27 to October 3, are 23, 20, 20, 22, 25, 31, an average of 23½ minutes, so that for the full moon of September 1 the retardation was slightly less than for the full moon of September 30, although the latter was much nearer the date of the equinox.

Possibly Sir George Greenhill, in his very interesting article (NATURE, September 27, p. 67), overlooked this peculiarity, due, of course, to the fact that the moon was at the first date much nearer the ascending node than at the second date. I may add that the average daily retardation in the time of rising is 50½ minutes, the average length of a lunar day being 24h. 50½m. In conclusion, I find that the interval between two successive returns of the moon to the meridian may be, in extreme cases, about twelve minutes less, and about seventeen minutes more, than the average.

C. T. WHITMELL.

Invermay, Hyde Park, Leeds, September 28.

Folk-lore and Local Names of Woodlice.

AMONST the readers of NATURE there are many, I feel sure, who are interested in the folk-lore and local names of the members of our fauna. May I appeal to such for any information bearing upon the heading of this letter?

Already nearly one hundred local names, such as bibble-bug, chisel-hog, cud-worm, palmer, lockchester, slater, tiggy-hog, etc., have been obtained, and the districts noted in which such are in use. Celtic and Gaelic names are particularly desired.

WALTER E. COLLINGE.

The University, St. Andrews, October 4.

The Convolvulus Hawk-moth.

IN reply to Mr. C. E. Robson's letter in NATURE of September 20, I write to say that I have lately become the possessor of two specimens of *Sphinx convolvuli*. The first one was caught at Deal on September 12; it shows signs of wear, and had probably come over from the Continent. The second I took myself in Queen Elizabeth's Walk, Stoke Newington, London, N., on September 22. It was in perfect condition, and had every appearance of having just hatched out. It was resting on a wall close to some bindweed, and it seems probable that it was bred there.

J. LAKER.

8 Allerton Road, N.16, October 4.

ORGANISATION OF CHEMICAL INDUSTRY AFTER THE WAR.

AMONG the problems comprehended under that somewhat elastic term "Reconstruction," none is more important to the economic future of this nation than the organisation of its chemical industry. The position in which we stood immediately after the outbreak of hostilities revealed only too plainly with what foresight and craft Germany had organised her trade and linked up her manufactures in view of the world-wide conflict upon which she deliberately and "of malice prepense" embarked after forty years of sedulous preparation. So intimate a union as was then made manifest between the governing powers and the leaders of industry, and of chemical industry in particular, in the common effort to secure the domination of the world is without a parallel in history.

The unbridled lust of conquest which moved Germany was not wholly the outcome of an arrogant and aggressive militarism. The spirit which still pervades masses of her people shows that the origin of the war had its roots much more deeply and widely spread. We are out to crush Prussianism, by which we mean the unscrupulous policy which actuates the dynasty which has become the predominant power and directing force among the Central Powers. But Prussianism would never have obtained its present influence unless it had appealed to a more deep-seated desire than territorial aggrandisement, or a more potent influence than the spectacle of increased dynastic pomp and pride. North Germans are far from being wholly beloved throughout the Empire. Still, in spite of the existence of other crowned heads and other capitals in Germany, Berlin as effectually rules the destinies of the Empire as Paris does those of France, which has only one metropolis and nowadays no dynastic embarrassments. Nor is militarism so universally popular that, even in Prussia, it could have maintained the struggle after so many disappointments and disillusionments and such widespread misery, unless aided and strengthened by other factors.

The fact is—and we cannot recognise it too clearly—the underlying and actuating force which still moves Germany, as it has moved her from the very beginning of the struggle, of which it is the real cause, is economic; it is the desire for power as the means of securing wealth. The process of peaceful penetration was too slow: she sought by force to gain, as by a stroke, what the methods of peace would assuredly have brought her if she had had only the patience to wait. The military party are not the sole aggressors; rather they have been the tools and cat's-paws of a still larger and more powerful class, of far wider influence and much richer in material power and intellectual efficiency, and united by a definite and common impulse. The military power of Germany may, and undoubtedly will, be crushed by military methods, but the power of that aggressive element in Pan-Germanism which has its roots in economic influences can be effectually combated only by economic means—that is, by organisation and the closest co-operation.

The conditions of a lasting peace which are faintly adumbrated—we cannot say defined—by Germany's present Chancellor, and which are re-echoed, more or less vaguely, by leading spokesmen of the only one of her Allies that counts among the industrial communities of the world, clearly indicate that amongst the overwhelming wreck and ruin that the Central Powers have brought upon themselves the only salvage that is now possible is their economic life, and every effort is to be made to secure it. The rulers of Germany now realise, as General Smuts tells us, that they have lost the war: the legend of their military invincibility is a myth, and their deluded people will soon recognise that fact. Their Chancellor now, apparently, fears that the nations may enter upon an economic war, and so stamp out that phase which Germany herself imported into it. With nearly the whole of the civilised world embittered against her, he is plainly apprehensive of her future in the struggle to which her greed and selfishness have brought her. Hence all the vague talk about the "freedom of the seas," which is meaningless in the mouths of those who countenance and direct a piracy which is infinitely more abominable, as an international menace, than that waged, of old time, by Barbary corsairs or the buccaneers of the Spanish Main.

We, like the Chancellor, deprecate the world-wide economic warfare he dreads. But we would remind him that his countrymen, by means fair and foul, had already embarked upon it, even before the beginning of military hostilities, and that now, in their rage and chagrin, they threaten to continue it with a tenfold violence and persistency. We regard the Chancellor's pious platitudes as on a par with his feeble and insincere generalities about the so-called "freedom of the seas." His motive is obvious. In both cases he desires to see the strength of this country undermined, whilst reserving to Germany unrestricted power to pursue her present policy.

It behoves us, therefore, to be watchful and alert. The Minister of Reconstruction has acted wisely in appointing a committee, as announced elsewhere in this issue, to advise him on the subject of the position of the chemical trades after the war. Dr. Addison has requested the committee to conduct its deliberations with a view to the creation of some organisation which should be adequately representative of the trade as a whole, and by means of which the trade may be enabled hereafter to continue to develop its own resources and to enlist the closest co-operation of all those engaged in the chemical industry.

We welcome the appointment of the committee, although we have some doubt as to whether its composition is altogether such as will command the confidence of the chemical trades as a whole. It consists of four members connected with the Ministry of Munitions, one gentleman attached to the Ministry of Shipping, three members

of the House of Commons more or less directly interested in chemical industry, together with the ex-president of the Society of Chemical Industry, who is a leading member of the coal-gas industry.

The committee's terms of reference are purposely somewhat vague and general, and it remains to be seen how they will be interpreted. In effect, however, they would seem to be limited to the creation, or suggested creation, of an organisation to be adequately representative of chemical industry; but, of course, much turns upon the functions with which this organisation should be endowed and the powers with which it should be entrusted, and it is in defining these functions and powers that the committee will either make or mar the whole scheme.

The matter is confessedly one of great difficulty and complexity, and involves far-reaching considerations. If the committee's deliberations result in the creation of what is practically a parliament of the industry in which all sections are adequately represented by persons of influence in industrial and commercial circles, and who, by virtue of their knowledge, experience, and position, are able to secure the confidence and co-operation of the Legislature and of Government departments, Dr. Addison's action will undoubtedly result in great benefit.

We trust, therefore, that the committee, which, it must be admitted, is somewhat bureaucratic in complexion, will take a broad and statesmanlike view of the question which has been submitted to it, and will not be hide-bound by purely party and departmental considerations, or by points of fiscal policy or the shibboleths of economic doctrinaires. The present times are somewhat out of joint: the future is full of changed conditions and demands a wide and bold outlook.

In an address delivered to teachers at the Regent Street Polytechnic on October 6, Prof. W. J. Pope, of Cambridge, showed how the huge chemical industry of Germany, primarily based on the coal-tar industry, and mainly built up by the genius and skill of her men of science and technologists, some of whom had spent their *wanderjahr* in this country, had been subordinated to the national effort to secure an economic supremacy in the world. He pointed out how the true meaning of that object-lesson had still to be learned by those who direct our national policy; he might have added, also, by that much larger and not less influential class which, in the long run, manages and controls our commercial and industrial development, namely, the purely moneyed class, which, for the most part, owing to its partial and limited education, is practically ignorant of the real value and potentiality of science in a civilised community.

That such is the case is evident from the past history of the synthetic colour industry in this country, where it originated. So long as this industry was under the management and direction of business men of science, like Sir W. H. Perkin and Edward Chambers Nicholson, it flourished and might have been extended. When it was fastened upon by capitalists who subordinated the chemist to the counting-house, it gradually languished and ultimately almost died out. Those who have succeeded in keeping it alive in this country have been largely of German or Austrian extraction, for the most part themselves trained as chemists, or who have had practical knowledge of the methods and policy of the great organisations in Germany to which Prof. Pope referred. There is an uneasy feeling abroad that the Department of Scientific and Industrial Research, in its well-meant efforts to administer the million pounds with which it has been entrusted, has, in regard to the resuscitation of the synthetic colour industry in England, failed to perceive the true principles by which alone the problem can be properly solved. This aspect of the matter may well receive the attention of Dr. Addison's committee.

THE STELLENBOSCH MEETING OF THE SOUTH AFRICAN ASSOCIATION.

THE South African Association for the Advancement of Science met in annual session for the fifteenth time in what will soon be the "university town" of Stellenbosch during the first week in July, under the presidency of Prof. John Orr, of the South African School of Mines and Technology, Johannesburg. The sectional meetings were held in the buildings of the institution at present known as Victoria College, but which will become the University of Stellenbosch from April 2, 1918. On the afternoon of Monday, July 2, the visitors were officially welcomed to Stellenbosch by the Mayor, and on the evening of that day, in the Conservatorium Hall, the president took the chair and delivered his address, an abridgment of which appeared in NATURE of September 27 (p. 76).

The association met from day to day in five sections, and ninety-seven papers were submitted, including the addresses of the five sectional presidents. Outlines of some of these are sketched below.

Prof. W. N. Roseveare, of Natal University College, Maritzburg, was president of Section A, and entitled his address "Mathematical Analysis in Science." He sketched the development of the Newtonian philosophy as the basis of all the mechanics of modern civilisation, from Galileo and Newton to Clerk Maxwell's electro-magnetic theory of light and the electron theory. The old theory had left some facts unexplained, but the principle of relativity developed during recent years by Einstein and Minkowski had been put forward to explain changes in the orbit of Mercury, and had reduced gravitation from a force to a quasi-geometrical property of space-time.

Prof. M. M. Rindl, professor of chemistry at Grey University College, Bloemfontein, chose as the subject of his presidential address to Section B "Phytochemical Research." In the course of the address Prof. Rindl emphasised the fact that every year many thousands of cattle die within the Union of South Africa, and many aboriginals

accused of culpable homicide are acquitted because adequate knowledge of the poisonous principles contained in indigenous plants is lacking. He urged, as a first step, co-ordination of effort amongst those actively interested in the problem. A census of the work already accomplished and of that still to be done would be comparatively simple, but none the less essential.

Mr. J. Burtt-Davy occupied the presidential chair in Section C, which embraces the biological sciences, and he devoted his address to setting forth the need for an organised biological survey of South Africa. An economic survey of the natural resources of the country had recently been recommended to the Government by the Central Committee on Industrial Research. He pointed out the importance of a biological survey as part of that economic survey, and suggested, as means to that end, definite co-ordination of existing biological workers, together with their equipment.

The Rev. B. P. J. Marchand presided over Section D and discussed in his address certain points relating to educational matters. He expressed gratification at the encouraging movements in the direction of solving the problems connected with (*a*) industrial education; (*b*) gathering in the large number of children who are not attending school; and (*c*) educating the public on the subject of child-life protection. He announced that 40,000*l.* was about to be expended on the erection of an up-to-date technical institute in Cape Town, and expressed himself in favour of the establishment of agricultural schools under the school boards, of rural schools of industry, and of school farms of an elementary type.

Of Section E the president was the Rev. Noel Roberts, who began his address by asserting that the native population of South Africa is undoubtedly one of the country's chief assets. Yet, said he, year follows year, and nothing is done to develop so valuable an asset. Only education can convert this vast amount of latent energy into productive power, and whether we send him to school or not, the native is being educated by the example of the ruling races—often, unfortunately, by the vices and evil habits of the white man—an education which sends him downhill. Mr. Roberts discussed the hindrances in the way of turning the native into a productive member of the community, and spoke highly of the lofty attitude generally adopted by the Government department which administers native affairs, the effect of which had been to arouse in the native mind a real affection for the Government which protects and cares for them.

The necessary limitations of space forbid referring in more than a few brief words to some of the eight dozen papers submitted to the various sectional meetings.

In Section A Mr. Innes, Union Astronomer, announced the discovery of a star in the constellation Centaurus, as near to us as, or possibly nearer than, α Centauri. Prof. J. T. Morrison read a paper on problems in terrestrial physics, the immediate outcome of which was the appointment of a standing committee to promote meteorological and geophysical research in South Africa. Mr. H. Pealing, lecturer in physics at the South African College, Cape Town, discussed the effect of vegetation on the rainfall of South Africa, and incidentally mentioned that the evidence regarding the desiccation of many large tracts of South Africa is so overwhelming that few will dispute the fact. The author of the paper sought to show that the amount of summer rainfall in districts far from the coast largely depends on the character and quantity of the vegetation in the intervening country. He urged afforestation of all suitable areas and the cessation of the wholesale denudation of tree, bush, and grass land.

Dr. S. J. Shand, professor of geology at Victoria College, read a paper before Section B on the geology of Stellenbosch, in the course of which he directed attention to a powerful dislocation that had occurred along the line of Jonkers Hoek, giving rise to what may be fairly called the Jonkers Hoek fault. Dr. A. W. Rogers, director of the geological survey of the Union, produced an interesting old report, of 250 years ago, on the copper fields of Namaqualand. Mr. G. F. Britten, of the Government Chemical Laboratory, Cape Town, read a paper on *Ecklonia buccinalis* as a source of potash. The seaweed occurs in large quantities on the South African coasts, and Mr. Britten thinks it would be easy to recover its potash on a commercial scale; he urged the institution of an exhaustive marine survey in this connection. Prof. G. H. Stanley, of the South African School of Mines and Technology, Johannesburg, read before the same section a paper on the prospects and possibilities of a South African iron industry, in view of the fact that the pre-war importations of iron and steel articles into South Africa used to approximate to six and a half million pounds sterling in value annually. He pointed out that on one small range alone, near Pretoria, above four million tons of ore assaying 45 per cent. of iron or more were in view, while the wattle timber that was annually burnt to waste in Natal could furnish 40,000 tons of charcoal.

Mr. C. F. M. Swynnerton, in Section C, showed how the ancient East African forests, once probably continuous from Melsetter to Beira, had been replaced by wooded pasture land. He suggested means for reconquest by forest of the land so invaded. Prof. J. W. Bews gave a detailed account of his study of plant succession in the thorn veld around Maritzburg, and a very useful contribution was made by Mr. T. R. Sim on the geographical distribution of the Bryophyta in South Africa. Dr. T. F. Dreyer contributed to the section a paper in which he offered suggestions regarding a mechanism for the inheritance of acquired characters. Mr. J. Leighton, in view of the increased demand for paper-making materials and textiles, gave the members of the section opportunities of seeing some new materials available in connection with each of these

industries. Insect pests of various kinds and means of destroying them were dealt with in a series of papers by Mr. C. W. Mally, and Dr. P. A. van der Byl contributed a valuable monograph on a fungus which attacks the Black Ironwood tree.

Mention must not be omitted of Prof. H. B. Fantham's excellent account of the intestinal and blood organisms which the war operations in Salonika and Gallipoli had afforded special opportunities for studying.

Section D was largely taken up with educational questions. Agricultural education in South Africa was dealt with by Dr. A. I. Perold, recently principal of the Government Agricultural School at Elsenburg and now professor of œnology at Victoria College, while by way of comparison Dr. C. F. Juritz read a paper on agricultural education in Australia. Entomological education in the United States was the subject of a paper by Dr. E. S. Cogan. Mr. W. J. Horne discussed the movement towards a national system of technical education, and the Rev. Prof. J. I. Marais completed the symposium with a paper on some forgotten factors in education. Section D, too, discussed the dearth of paper-making materials, an account being given by Dr. Juritz of the grasses of the eastern coast belt of the sub-continent available for paper-making: these grasses were mainly species of Andropogon, Erianthus, and Anthistiria.

The results of mental tests applied to Zulu students at a mission station in Natal were discussed by Mr. S. G. Rich before Section E. The author urged continuance of the investigation with the view of settling the question whether the native mind ceases growth at puberty. Dr. C. T. Loram at a later stage contributed a paper dealing with the same question, which he answered in the negative, ascribing appearances to the contrary to the courses of study and methods of teaching adopted in native schools. He reiterated suggestions made at the Maritzburg meeting a year ago by the Rev. J. R. L. Kingon that part at least of the course of study should be conducted in the Kaffir vernacular. The Rev. W. A. Norton read some important papers before Section E: in one of these he urged the need and value of an academic study of native philology and ethnology, and in another he emphasised the advantages of stenography as an aid to the phonetic analysis and comparison of the Bantu languages. A very interesting paper on native ideas of cosmology was contributed by the Rev. S. S. Dornan, and equally interesting was one read by Mr. J. McLaren, who illustrated the wisdom and the wit of the Bantu people by numerous quotations of their proverbial sayings.

Prof. Orr, at the conclusion of his presidential address on the opening evening of the session, presented the South Africa medal and an award of 50*l.* to Prof. J. D. F. Gilchrist, professor of zoology at the South African College, in recognition of his researches in marine biology. There were two evening discourses of the usual popular type during the week, one by Prof. Gilchrist on the marine animals of South Africa, and the other by Mr. H. E. Wood, of the Union Observatory, on "Some Unsolved Problems of Astronomy."

Next year's meeting will be held at Johannesburg, with Dr. C. F. Juritz as president.

THE PHYSIQUE OF RECRUITS.

In the summer of 1916 the Board of Scientific Studies was established under the ægis of the Royal Society to serve as a means of placing knowledge in the possession of scientific and technical societies at the disposal of Government departments. At the first general meeting of this board in July, 1916, the urgency of a physical survey of the nation, to discover whether or not there existed definite evidence of physical deterioration, was discussed. Emphasis was laid by various speakers on the fact that an Interdepartmental Committee had reported in 1904 that such a survey was necessary. Nothing, however, had been done. The mobilisation of a national Army had provided an opportunity, as well as a need, for such a survey.

The Board of Scientific Studies requested the Royal Anthropological Institute to report on the desirability and possibility of such a survey. The institute having reported that such a survey was both desirable and possible, the board formed an Anthropological Survey Sub-Committee to consider the manner in which such an investigation could best be carried out. This sub-committee has not yet reported to the Board of Scientific Studies, but we understand that it is seeking for the means of carrying out such a survey through the Government departments which have directly to do with the health and physique of the nation: the Recruiting Authority—now the Ministry of National Service—the Local Government Board, and the Board of Education. Representatives of these departments have joined the Anthropological Survey Sub-Committee, and it is hoped that a practical scheme may be formulated at an early date.

Meanwhile American anthropologists have stolen a march on their British colleagues. When the United States entered the war the National Research Council was at once created to serve the same purpose as our Board of Scientific Studies. Its Anthropological Committee, formed to advise in the selection, standardisation, and examination of recruits, has already issued its report and recommendations. It proposes that six of the sixteen great concentration camps should be selected for an anthropological survey—two in the Eastern, two in the Middle, and two in the Western States —and that special men, who had been trained to use exactly the same anthropometrical methods at the National Museum at Washington, should be dispatched to carry out a survey of the men in the selected camps. The points for investigation have been reduced to a minimum, namely, standing and sitting heights, three dimensions of the head, two

of the face, two of the chest, with precise records of the colour of skin, eyes, and hair. The statistical staff of the Prudential Insurance Company of America has undertaken to deal with the data collected, while the Smithsonian Institution will faciliate the publication of results.

Although the intentions of the British committee are more wide-reaching and aim at ascertaining the condition of all elements in the population, it is to be hoped that the observations taken in Britain and America will be capable of direct comparison—for, beyond doubt, the bulk of the population of the United States has a British ancestry.

PROF. CHARLES LATHAM.

By the sudden death of Prof. Charles Latham on September 27, the University of Glasgow has lost an eminent member of its teaching staff in the department of applied science. In 1902 the late Dr. James S. Dixon, an eminent coalmaster of Glasgow, "recognising the want of a means of teaching the higher branches of the theory and practice of mining in the University, and the desire for acquiring such knowledge displayed by many young men connected with mining," gave the University 10,000*l*. for the foundation of a lectureship in the subject. In the various branches of engineering, and in naval architecture, curricula were already provided which prepared for the degree of B.Sc. in applied science. Mining was added as an alternative curriculum, and the new department was entrusted to Mr. Latham. He had been trained in the Wigan School of Mines, and had been assistant general manager of the Moss Hall Coal Co. For nine years (1893–1902) he was director of mining at University College, Nottingham. The first Dixon lecturer speedily made his department efficient, and his numerous courses of instruction attracted many pupils.

In 1907 Dr. Dixon supplemented his original endowment by 6500*l*., and the University, with the consent of the Privy Council, transformed the lectureship into a chair. To this Mr. Latham was forthwith appointed, the electors including H.M. Inspectors of Mining and the presidents of the Scottish Mining Institute and the Coalmasters' Association. In the new chair Prof. Latham continued to devote himself to the advancement of his subject by teaching and research. He raised a considerable Equipment Fund, by means of generous contributions from the leaders of the Scottish mining industries, who had great confidence in his policy and character. Assisted by the fund, the University was enabled to equip the museum and laboratory of the department with valuable exhibits and apparatus, and Prof. Latham gave himself to the training of his pupils and assistants in the practical and experimental sides of their work, and in original investigations on mine-pumps, winding machinery, coal-cutting, inflammable gases, life-saving appliances, etc. His course was recognised by the Home Office as equivalent to two of the five years' practical training required under the Coal Mines Acts for the qualification of mine manager. By arrangement with a number of the largest collieries in Scotland, his students were enabled, during the summer months of each year of the course, to acquire experience of mining practice. Many of them now occupy responsible positions in the industry, and in technical institutions throughout the country. Prof. Latham served on numerous advisory and other committees relating to mining, and published, in the Transactions of the Mining Institute and elsewhere, memoirs of importance on his researches in the above-mentioned subjects.

NOTES.

THE Minister of Reconstruction has appointed a committee to advise him as to the procedure which should be adopted for dealing with the position of the chemical trades after the war. The committee consists of the following members:—Sir Keith W. Price (chairman), Mr. J. Anderson, Mr. J. F. Brunner, Dr. C. Carpenter, Prof. J. G. Lawn, Sir William Pearce, Mr. K. B. Quinan, and the Right Hon. J. W. Wilson. Mr. G. C. Smallwood, Ministry of Munitions, will act as secretary to the committee. The officers of Government departments are appointed with the concurrence of their respective Ministers, and the other members of the committee have been appointed at the suggestion of a representative meeting of chemical manufacturers. Dr. Addison has requested the committee to conduct its deliberations with a view to the creation of some organisation which should be adequately representative of the trade as a whole, and by means of which the trade may be enabled hereafter to continue to develop its own resources and to enlist the closest co-operation of all those engaged in the chemical industry.

ON October 6 Prof. W. J. Pope addressed a meeting of teachers at Regent Street Polytechnic on the neglect of expert knowledge of scientific subjects by the British Government. Germany, he is reported by the *Times* to have said, prepared for war by the establishment of a huge chemical industry, which was built up round the coal-tar industry, and then by exporting a large proportion of the world's requirements of coal-tar colours and pharmaceutical and photographic products. This success was achieved in spite of the fact that England once possessed the whole of the heavy chemical industry of the world. We formerly produced practically all the nitric and sulphuric acids and the greater part of the alkali used throughout the world. This industry has been taken from us as the result of Germany's foresight and exploitation of scientific ability. The coal-tar industry was established originally in this country, and until ten years ago Germany was practically dependent on us for crude coal-tar and for the simpler first products separated from coal-tar. Alluding to the establishment of the Department of Scientific and Industrial Research with an endowment of 1,000,000*l*., Prof. Pope remarked that the question to be answered is why that experiment was not made twenty years ago, at a time when it would have been undoubtedly successful in preventing the horrors of the last three years. We have suffered in the past from the exclusively British method of making the specialist entirely subservient to the administrator, the administrator being generally chosen because he is available, because he is politically acceptable, and because he knows nothing whatever about the subject which is to be administered, and is therefore not likely to be prejudiced by any previous convictions. The process of appointing someone who knows nothing to super-

vise the work of someone who does know how to do the job seems to have been at the bottom of a great many of our misfortunes in the past. In 1915 the Government applied the same method to re-establish the coal-tar industry in this country. An organisation was established in which all the people in control were men who knew nothing of chemistry or science, and, naturally enough, the Government organisation has proved a failure. Organisation apparently was to do everything that was necessary, and consequently private effort was to a considerable extent hampered. Such prevalent, but entirely mistaken, activity arises, Prof. Pope claimed, from a lack of education. If it were generally demanded that no person should be regarded as reasonably educated who had not mastered the rudimentary principles of natural science and of scientific method, this mistaken policy in connection with the coal-tar colour question would have been impossible.

On the invitation of the British Engineering Standards Committee, the American Institute of Electrical Engineers has sent over Mr. H. M. Hobart to represent the institute at a conference to be held with Sir Richard Glazebrook's Panel Committee on Standardisation Rules for Electrical Machinery. Mr. Hobart is the author of several standard treatises on electrical machinery, and was for many years a lecturer at Faraday House Engineering College before he returned to America about ten years ago. He is decidedly *persona grata* to the engineers in this country, and a happier or more tactful choice could not have been made. The standardisation rules of the American and English electrical engineers are in substantial agreement, and we see no reason why complete agreement should not be obtained. The Americans have had far greater experience with pressures exceeding 50,000 volts than we have had, and they are fully aware that testing apparatus with very high voltages may permanently weaken the insulation, although the apparatus may survive the test. The exact way of taking the temperature measurements of machines under load and the methods of testing the dielectric have been discussed at previous conferences. Electricians are practically unanimously in favour of the metric and decimal systems, but the standard pressure for lighting in this country seems to be anything between 220 and 240 volts. It is to be hoped that the lead which the Glasgow Corporation gave to the country many years ago, by fixing 250 as the standard voltage for lighting, will be generally adopted.

The recent air raids have provoked much discussion as to our future air policy, and as to possible improvements in aircraft design. The question of reprisals is more a moral than a technical one, as there is no doubt of our ability to carry out effective raids on German towns. Lord Montagu of Beaulieu, in a letter to the *Times*, points out that the air-raid casualties are really small, and fewer than those due to London traffic. This is poor consolation, and should not prevent the utmost efforts to secure an effective means of defence. At a meeting "in support of an increased air service," held at the Central Hall, Westminster, on October 4, Mr. Joynson Hicks criticised the Government very severely, stating that warnings had been neglected and that progress was consequently slow. He spoke of the improvement in aircraft during the last few years, and said that in his opinion another year would see machines flying at 250 miles an hour instead of 150. He implied that the Government knows that such machines are possible, but is not preparing for them. Such a statement as the above shows a lack of knowledge of the principles governing flight. A machine must be able to land at a reasonably low speed, as well as to fly at a high speed, and the landing speed at once imposes a limit on the top speed. Thus, with a landing speed of forty miles per hour a machine of good design, weighing one ton, needs 200 horse-power to fly at 100 miles per hour, and would require 1700 horse-power to fly at 200 miles per hour. If the landing speed is raised to eighty miles per hour—a very high value in practice—90 horse-power will be required at 100 miles per hour, and 400 horse-power at 200 miles per hour. Mr. Joynson Hicks's 250-mile-an-hour machine would require 800 horse-power to fly it, even with a prohibitive landing speed of eighty miles per hour. Such a machine is obviously impracticable with present-day engines, and with any engine likely to be evolved in the near future. The engine alone would weigh one ton, which is the total weight of the machine for which the above calculation was made. Our best present-day machines are near the limit of practicability with existing engines, and every possible effort is being made to improve their performance by careful scientific attention to details of design.

Dr. Addison, the Minister of Reconstruction, speaking on October 3 at the annual meeting of the Library Association, said that one of the features of the programme which appealed to him was the movement, which was apparently making considerable progress, for the formation of technical and commercial libraries and for the setting up of research libraries to suit the particular needs and industries of various districts. If we are to pay for the war—and it is not necessary to put the matter on a higher plane than that—we want the different trades and industries of the country to organise more and more for the production and dissemination of useful and necessary information. A working relationship between higher educational authorities and the business community is absolutely essential to our industrial welfare, and public libraries can do a valuable work by placing information useful to industry at the disposal of the community. Certain recommendations were made at the meeting. The council of the association is of opinion that it is of urgent national importance to increase the supply of scientific and technical books and periodicals, the existing supply being quite inadequate for higher research, and, in many places, insufficient for the requirements of the student and the artisan. To this end it was strongly urged (*a*) that local authorities should afford more generous support to public libraries for the provision of scientific and technical literature; (*b*) that municipal and other library authorities and institutions should co-operate in issuing union catalogues of technical books, and adopt such other co-operative methods as will make their resources available over wider areas; (*c*) that a State scientific or technical library should publish periodically a descriptive list of selected books in science and technology; (*d*) that a closer union should be arranged between State and copyright libraries on one hand, and municipal libraries on the other, so that the resources of the former may directly or indirectly be made available for scientific and technical students in the great industrial areas of the provinces; and (*e*) that funds should be provided for some State-supported library, such as the Science Library of South Kensington, or a library controlled by the Department of Scientific and Industrial Research, to purchase books required for research, and to make them available for loan to public libraries. All the recommendations were adopted unanimously.

A general discussion on pyrometers and pyrometry will be held by the Faraday Society at the Royal Society of Arts on Wednesday, November 7. Sir Robert Hadfield, president of the society, will preside over the

discussion, and deliver an introductory address. Instruments for high-temperature measurements will be exhibited by leading makers.

PROF. G. H. BRYAN has received from the Department of Scientific and Industrial Research a grant to enable him to complete the researches into some of the unsolved problems as to the effects of atmospheric and other disturbances, such as gusts, air-pockets, bomb-throwing, etc., upon aeroplanes, referred to in his "Stability in Aviation." He has been granted leave of absence for a year from the University College of North Wales, where he is professor of mathematics, and has proceeded to the University of Bristol, where he proposes to work for a time.

ANNOUNCEMENT is made that Mr. Walter Long, who has been requested by the War Cabinet to take control of all questions affecting petroleum oils and petroleum products, has appointed Prof. J. Cadman to be his technical adviser and liaison officer between the various Government departments. Prof. Cadman will also take charge of an organisation to be established for giving effect to Mr. Long's instructions, and will assume the title of Director of the Petroleum Executive. Mr. E. S. Shrapnell-Smith has been appointed economy officer to the Petroleum Executive, and he will be concerned in introducing economies both in the Services and in the civil use of petroleum and petroleum products. The headquarters of the Petroleum Executive are at 8 Northumberland Avenue, W.C.2, to which all communications should be addressed.

MELBOURNE newspapers of August 10 and 11 contain accounts of large magnetic disturbances which occurred on the afternoon of August 9 and on the forenoon of August 10, Australian time. These clearly correspond with disturbances recorded in England during the morning and late evening of August 10, Greenwich time. The earlier of the two disturbances, lasting from about 2 to 8 p.m. local time, was accompanied by bright aurora. At Melbourne there was a brilliant display of streamers for about an hour. At Ballarat the aurora, being of a ruddy tint, was mistaken for a conflagration, and the fire brigades turned out. There were also strong earth currents throughout Australia, interfering with the telegraph service, especially in Victoria and New South Wales.

THE Royal Photographic Society is holding its annual exhibition this year in the society's own house at 35 Russell Square, W.C. Admission is free for about six weeks. The autochrome process still holds its own for colour transparencies, though the few results on Paget plates leave little or nothing to be desired so far as an inspection, without the original for comparison, is concerned. The Astronomer Royal, Greenwich, has contributed recent photographs of sun-spots, nebulæ, comets, and star regions. Among other astronomical photographs taken with telescopes of very large aperture are several by Mr. J. H. Reynolds, of Birmingham. These include series of the moon, Jupiter, Brooks's comet, and the great nebula in Orion. The photomicrographs are far more numerous than usual, and vary very much in quality. An experiment by Dr. Rodman, made at the suggestion of Capt. Owen Wheeler, of using a more highly corrected lens as eyepiece (a Ross ½-in. achromatic objective was used instead of the "ordinary ocular") distinctly discourages any further attempts in this direction. Mr. Ernest Marriage shows an extensive series to demonstrate the comparative proportion of starch in plant roots, especially in those plants that market-gardeners would wish to be rid of. He photographs sections (×5) as ...t, and also after treatment with iodine, the darkening with iodine indicating starch. Photographs at ×250 show the starch granules. There are notable collections of radiographs, natural history photographs, and other matters too numerous to mention. Doubtless the photographs of the widest general interest are those contributed by the Royal Flying Corps. The exigencies of the times have caused aerial photography to advance to a perfection scarcely thought possible a few years ago. The photographs show definitely the changes in buildings, trenches, etc., during the various stages of the war.

IT is announced that the Ministry of Munitions does not regard coal-gas as coming within the category of a petrol substitute. On the question of the unrestricted use of gas, the Ministry states that it is consulting the Home Office. The motor industry has now taken up this substitute for petrol, which involves only a slight alteration to the engines of the vehicles. Gas has been used as the motive power in many char-à-bancs during the summer season, the fuel being stored in a large bag carried on the roof. The question as to how gas can be stored in motor-cars, taxi-cabs, etc., has given rise to the adoption of several plans. Open motor-cars are not adapted to the carriage of gas-bags, and the experiment of using light trailers for that purpose is being tried. In the case of taxi-cabs little difficulty will arise, and a slight alteration of the front seats on the top of motor-omnibuses is all that is necessary for the storage of bags. It is likely that gas will be adopted largely, since it can be obtained at about one-fourth the present price of petrol. Owing to the difficulty of procuring steel cylinders, compressed gas is not likely to come into use during the war; there is also the point to be considered that coal-gas stored under pressure is liable to deteriorate.

A REUTER message from Tokio, dated October 1, which appeared in the *Times* of October 4, reports the occurrence in Japan of a typhoon of unprecedented violence, which swept over Tokio on the morning of that day, lasting for four hours. The casualties caused by the visitation appear to have been deplorably numerous, and the destruction of property exceptionally great, thousands of people being rendered homeless. The typhoons of the North Pacific and China Seas are divided by the Rev. J. Algué, S.J., director of the Manila Observatory, in his "Cyclones of the Far East," into classes, according to the zones of their trajectories: those of the North Pacific, all of which keep to the west of the twenty-fourth meridian, East; and those of the China Sea, which cross this meridian. It is the former to which the typhoons that visit Japan belong. Fr. Algué then groups these conformably with the months of their occurrence; the mean inclination of their branches (1) before, (2) after they have recurred; also the mean latitude of their vertex. Reduced to three groups, December to March, inclusive, is the first; April, May, October, November, the second; June to September, inclusive, the third. The typhoon of October 1 belongs rather to the third group of trajectories than to the second, because in the case of the former the latitude of its vertex is highest of all the groups. The zone of origin of typhoons of the first group lies between the parallels of 5° N. and 12° N.; that of the second between 6° N. and 17° N.; that of the third between 8° N. and 20° N. In the Philippines a typhoon with an hourly velocity of motion exceeding twelve nautical miles is said to travel rapidly; when at fewer than from six to twelve miles an hour to move slowly, but to have a regular velocity when it progresses at that rate.

AN interview with Sir Henry Trueman Wood published in Sunday's *Observer* (October 7) brings together several interesting reminiscences of his long association

with the Royal Society of Arts, of which he was secretary from 1879 until his recent retirement. Among the distinguished representatives of applied science who were chairmen of the council from that year onwards were Sir Frederick Bramwell, Sir William Siemens, Sir J. Wolfe Barry, Sir William Preece, and Sir William White. Dr. Dugald Clerk has just retired from the chairmanship, and has been succeeded by Mr. Campbell Swinton. The society played a large part in the foundation of the Great Exhibitions of 1851 and 1862, and, through these, of that long series of international exhibitions which had such far-reaching influence on the arts, as well as on industry and trade. Sir Henry had much to do with the organisation of the Health, Inventions, and Colonial Exhibitions at South Kensington, the Paris Exhibition of 1889, and the Chicago Exhibition of 1893, for which the Government appointed the council of the Society of Arts as the British Commission. With regard to this exhibition, Sir Henry, who managed the British Section in Chicago, said:—"The amount given by our Government, though fairly liberal, was nothing compared with that which the German and French Governments gave. The Germans had never exhibited at big exhibitions before, because they had all been held in France, and after the Franco-Prussian War they would have nothing to do with them. They gave their commissioner an absolutely free hand. He told me himself he had as much money as he could do with. The result was that they made a much finer show in buildings than we could do. I do not think their actual exhibits were as good as ours, but the way in which they were shown was infinitely superior." Throughout his long association with the society, Sir Henry was always ready to assist other organisations having the application of scientific knowledge as their object. In the early days of the British Science Guild his active co-operation in many directions, and the hospitality afforded by the society as regards the use of rooms for meetings, were of the highest assistance; the aid thus given will long be gratefully remembered.

In the issue of *Knowledge* just published (No. 582) MM. Albert and Alexandre Mary describe experiments, in continuation of the late Dr. Charlton Bastian's work, on the development of micro-organisms in carefully sterilised solutions of certain salts, *e.g.* potassium ferrocyanide and ferrous sulphate. Tubes after being charged were sealed and sterilised for ten minutes at 130° C. The tubes, after standing for a year and a half, were opened and examined, and all yielded growths of micrococci which could be cultivated in iron lactate solutions. They affirm, therefore, the correctness of Dr. Bastian's work. In the same number Dr. Butler Burke, commenting on Mr. Onslow's communication to Nature of February 22 last on a repetition of Dr. Bastian's experiments with negative results, suggests that some kind of radiation other than sunlight, such as radioactivity, may prove to be the stimulant required to start vital processes in non-living matter, and so to cause the spontaneous generation of the living from the non-living.

Mr. J. A. Cushman has published (Bulletin 71, U.S. Nat. Mus., pp. 103, 52 text-figures, 39 plates, 1917) the sixth and last part of his work on the Foraminifera of the North Pacific, which deals with the single family Miliolidæ. Preceding the systematic account of the species recorded are detailed descriptions of the development of nine genera (and observations on their derivatives), beginning with Cornuspira.

In the report of the Dove Marine Laboratory at Cullercoats for the year ending June 30 Prof. A. Meek and Miss Stone record the results of examination of about 3000 herrings caught off the Northumberland coast. These show that the year 1916 was abnormal in that the herring caught were for the most part a year older—their scales having four winter rings—than those obtained during the years 1912–15. Miss Jorgensen gives a short description of the development of the common shore sponge, *Grantia compressa*. She agrees with Prof. Dendy that the oögonia arise from collared cells. Prof. Meek contributes a brief account of the Phoronidea, making special reference to *Phoronis ovalis*, which was rediscovered recently by Dr. Harmer in a shell obtained off the Northumberland coast. Prof. Meek states his reasons for believing that *Actinotrocha branchiata* is the larva of *P. ovalis*. He reports on larval lampreys collected in the North Tyne, but although the larvæ are so common, efforts made to secure the adults have thus far failed. He directs attention to the serious nature of the pollution of the Tyne in the neighbourhood of Newcastle and the consequent destruction of descending kelts and smolts and of sea-fish which are drifted up the river, and urges that steps should be taken to render effluents innocuous before they are poured into the river.

In his presidential address to the Quekett Microscopical Club, published in the Journal, vol. xiii., Prof. A. Dendy gave an interesting account of the development of the chessman spicule of the sponge Latrunculia, and discussed the view that the position of the whorls of outgrowths on the spicule correspond with the nodal points of a vibrating rod. The evidence suggests that the formative cells of the spicule are sensitive to vibrations and avoid the internodes, taking up their positions on the surface of the young spicule at the points of comparative rest of the vibrating rod, and thus the whorls present in the adult spicule are formed at these points by local accumulations of silica. Profs. Dendy and Nicholson have since published (see Nature, June 14, p. 318) an account of their mathematical study of a spicule with simpler whorls, the observed positions of which correspond closely with the calculated positions of the nodes in a vibrating rod similar in form to that of the shaft of the spicule when the nodes are commencing to develop. In the same volume of the Quekett Club's Journal Mr. G. T. Harris gives the results of studies on the desmid flora of Dartmoor, based on two hundred gatherings made in July–October, 1915 and 1916. The total number of species and varieties recorded is about 400. Some of the rarer species are figured and are the subject of special notes. The richness of the desmid flora of Dartmoor lends support to the view that "the rich desmid areas correspond geographically with pre-Cambrian and older Palæozoic outcrops."

The principal features of scientific interest in the current number (vol. xlii., parts 2 and 3) of the Journal of the Royal Horticultural Society are the reports on the experimental work at Wisley and a report of investigations relating to Paradise apple stocks, which is contributed by Mr. R. G. Hatton as the first report of the Wye College Fruit Experiment Station, East Malling. The latter is a detailed record of experimental work on this important subject which has been carried out at the station since November, 1912. Nine distinct types have been identified from English sources, whilst six other types have been obtained from German sources. The report is profusely illustrated, and reveals substantial progress towards the solution of what has long been regarded by fruit-growers as an important problem.

Agriculturists are indebted to Prof. T. B. Wood for a useful series of tables of the composition and

nutritive value of feeding-stuffs which is issued by the Cambridge University Press. The tables cover the whole range of farm feeding-stuffs, and give information as to average composition, digestible nutrients, food units, nutritive ratios, and relative values for maintenance and productive purposes, the last-named being expressed in the now familiar form of "starch equivalents." Wherever possible the averages are based upon analyses of the materials actually used by British farmers, and this feature alone renders the tables invaluable and indispensable to all concerned in the inculcation and carrying out of rational methods of feeding live stock in this country.

THE Food Production Department of the Board of Agriculture and Fisheries has issued a report (Miscellaneous Publications, No. 19) on the methods adopted in breaking up grass land during the past winter, and on the results achieved. The report is based upon the replies furnished by more than 300 farmers in fifty-five counties, to whom schedules of questions were addressed. In view of the difficulties attending the work last spring the results are considered to be very satisfactory, failure being reported in only one-fifth of the cases dealt with. Although some of the failures cannot be accounted for, most of them were due to reasons which further experience should enable farmers to avoid. Failures occurred chiefly in the south and east. In by far the greater number of cases wireworm was reported as the ostensible cause of failure, but it is suggested that in many of these cases the damage was primarily due to the drying out of the newly ploughed soil through lack of proper tillage, whilst in other cases it was almost certainly due to fritfly. There was general unanimity that the production of a firm seed-bed by pressing or heavy rolling after the plough is of prime importance for success. In a discussion of the lessons drawn from the successes and failures of 1917 much useful guidance is furnished as to time of ploughing, subsequent cultivation, and manuring in relation to land of different types. A brief *résumé* of the report is issued separately as Food Production Leaflet No. 5.

MESSRS. HONDA AND ISHIWARA describe, in a report from the Alloys Research Institute of the Tohôku University, Japan, the results of tests on the magnetic properties of manganese-antimony alloys in a field of about 500 gauss. Manganese is paramagnetic, and antimony diamagnetic, but their compounds, Mn_3Sb_2 and Mn_2Sb, are both ferromagnetic with a critical temperature at 315° C. Magnetisation at different high temperatures was also measured. This gives important data with regard to the structure of the alloys.

IN a report from the Alloys Research Institute of the Tohôku University, Japan, Messrs. Honda and Murakami publish certain data with regard to the thermomagnetic properties of the carbides found in steels. They find that iron cementite is ferromagnetic, the specific magnetisation of which ($\rho=2\cdot559$) in a field of 500 gauss is 19·7. Its critical temperature is 215° C. In the free state it is almost wholly decomposed into its components by heating it sufficiently long at 900° C. The double carbide of iron and tungsten found in low tungsten steels is also ferromagnetic, and its specific magnetisation ($\rho=1\cdot435$) in a field of 500 gauss is 15·5. Its critical temperature is 400° C., and in the free state it is decomposed on heating to 850° C.

THE August number of the Journal of the Franklin Institute contains a valuable outline of the publications on the subject of the submarine and its equipment which have appeared in the technical Press during the last six years. It is due to Helen R. Hosmar, and deals in order with the history of the development of the submarine, its proper function in war, the power and dimensions of the most recent submarines built in different countries, the various forms of internal-combustion engine used for propulsion on the surface, and of storage cells for use when submerged, the periscopes, and the forms of apparatus for signalling to and from submarines. A list of builders and a bibliography conclude the article, which occupies fifty-five pages of the journal. The outlines given are sufficient to give the reader a good general knowledge of the rapid advances which have taken place during the last few years, while the bibliography provides the references which enable the specialist to turn to the original sources for detailed information.

AN article in *Engineering* for October 5 contains some interesting particulars of ferro-concrete shipbuilding. It is satisfactory to learn that Lloyd's Register of Shipping has approved plans for the construction of a number of such ships up to 500 tons dead-weight capacity. A director of the Norwegian Veritas has lately given his views, unofficially. He is convinced that ferro-concrete, under normal conditions, will be used for lighters, floating docks, buoys, etc., where the weight does not play a very important part. So far as sea-going vessels are concerned, he is of opinion that the weight of ferro-concrete vessels will detract from their carrying capacity to a serious extent. The Fougner yard in Norway has already commenced work on its eighteenth ferro-concrete floating structure—a floating dock—while several vessels up to 1000 tons dead-weight have been contracted for. Sister companies of the Fougner firm are in course of formation in England and America. M. Harald Alfsen, of the Norwegian company, has from the outset been convinced that ferro-concrete boats should be built bottom uppermost, and by using only an inner shuttering, or only outer boarding, so far as the vertical sides are concerned. The vessel takes the water bottom upward, in the position in which it is cast, and is turned upright after launching. The article contains an illustrated description of the ferro-concrete ship, *Beton I.*

ONE of the completest and most conveniently arranged special catalogues of second-hand books that have recently reached us is New Series No. 81, Zoological, just issued by Messrs. John Wheldon and Co., 38 Great Queen Street, W.C.2. It is divided into two parts—classified subjects and faunas of all countries—and should appeal to all zoological readers, being very easy of reference and containing many scarce works and others not easily obtainable at the present time, being of foreign origin. We notice that Messrs. Wheldon are offering for sale a set of the *Phil. Trans.* of the Royal Society from 1665 to 1913; Proceedings of the Royal Society from 1800 to 1916; the *Ibis* from 1859 to 1915; Bulletin of the British Ornithologists' Club, vols. i. to xxxiv.; Transactions of the Linnean Society from 1791 to 1916; a complete set of the *Zoologist*; and NATURE from its commencement to 1916.

THE new announcement list of the Cambridge University Press contains the following books:—"The Theory of Electricity," G. H. Livens; "British Grasses and their Employment in Agriculture," S. F. Armstrong, illustrated; "Instinct in Man: A Contribution to the Psychology of Education," Dr. J. Drever; "Locke's Theory of Knowledge and its Historical Relations," Prof. J. Gibson; "Agriculture and the Land," G. F. Bosworth (Cambridge Industrial and Commercial Series); and a new and revised edition of

"Manuring for Higher Crop Production," Dr. E. J. Russell.

A BOOK which should be of interest and value is announced by the Chiswick Press, viz. "The Ancient Earthworks of the New Forest," described and delineated in plans founded on the 25-in.-to-one-mile Ordnance Survey, with a coloured map showing the physical features of the ancient sites of the New Forest founded on the 1-in.-to-one-mile Ordnance Survey, by H. Sumner.

MESSRS. LONGMANS AND CO. announce a new edition of Sir W. Crookes's "The Wheat Problem," containing an additional chapter on "Future Wheat Supplies," by Sir R. H. Rew, and an introduction by Lord Rhondda.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS OF ENCKE'S COMET.—The following ephemeris of Encke's comet, which is due at perihelion on March 25, 1918, is given by M. Viljev :—

1917	R.A. h. m. s.	Decl. ° ′	Log r	Log Δ
Oct. 11	23 41 24	+10 17·5		0·1732
15	34 27	9 37·9		
19	27 45	8 57·2	0·3757	0·1674
23	21 24	8 16·4		
27	15 29	7 36·1		0·1670
31	10 2	6 57·0		
Nov. 4	5 12	6 19·7	0·3473	0·1709
8	23 0 53	5 44·7		
12	22 57 12	5 12·6		0·1780
16	54 13	4 43·6		
20	51 53	4 18·0	0·3145	0·1869
24	50 9	3 56·0		
28	49 0	3 37·6		0·1964
Dec. 2	48 27	3 22·9		
6	48 29	3 11·7	0·2762	0·2054
10	49 3	3 4·2		
14	50 8	3 0·3		0·2130
18	51 45	2 59·9		
22	53 50	3 2·9	0·2307	0·2188
26	56 22	3 9·2		
30	22 59 19	+3 18·6		0·2218

THE NEW STAR IN N.G.C. 6946.—A further account of the new star discovered by Ritchey in the spiral nebula N.G.C. 6946 (H. iv. 76 Cephei) has been given by Dr. Max Wolf (*Astronomische Nachrichten*, No. 4902), including a reproduction of a photograph taken with the Königstuhl reflector on August 21. The region is very rich in faint stars, but the only B.D. star in the neighbourhood is +59° 2662, magnitude 9·5, which is slightly preceding, and about 7′ north of the centre of the nebula. The nova was identified by comparison with earlier photographs of the nebula, and its estimated position, for 1917·0, was R.A. 20h. 33m. 3·1s., declination +59° 50′ 15″. The central star of the nebula follows the nova by about 4·05s., and is 105″ to the north. On August 21 the magnitude of the nova was estimated to be 13·5; on the photograph reproduced it appears to be less bright than the central star, but this is an illusion produced by the nebulosity about the latter, as in photographs taken with short exposures the nova was considerably the brighter. The nebula extends about 6′ to 7′ in the direction east and west, and the spirals exhibit a very complex knotted structure. The nova is situated near the southern end of an arm which runs obliquely from east to south of the central star. It was not possible to photograph the spectrum of the nova on account of the feeble luminosity.

WORK-HARDENED METALS.

ONE of the most interesting of the papers presented at the autumn meeting of the Institute of Metals was that by Prof. Jeffries, of the Case School of Applied Science, Cleveland, U.S.A. Hanriot came to the conclusion in 1912 that metals subjected to very high hydrostatic pressures, of the order of 10,000 kilograms per square centimetre, even though they underwent no change of shape, showed an increase of hardness (Brinell test). Although cubes of silver, copper, and aluminium showed a considerable increase of ball-hardness in these experiments, he decided that in no case were they appreciably deformed, and that the pressure was sufficient for hard-hammering the metals without deformation. Prof. Jeffries reviews this work, and has repeated the experiments. Tests were carried out by Dr. Bridgman with pure aluminium and an alloy containing 88 per cent. of aluminium and 12 per cent. of copper, in the form of cylinders 7/16 in. diameter by ½ in. long, the dimensions of which were accurately measured. The tensile strengths and scleroscope hardness values of the materials were determined with the following results :—

	Tensile stress lb. per sq. in.	Scleroscope hardness
Aluminium	14,890 ...	6·5
Aluminium-copper alloy ...	31,950 ...	24·0

Cylinders of each kind of metal were then exposed to a maximum pressure of 12,400 kg. per sq. cm. at 25° C., the transmitting liquid being petroleum ether mixed with kerosene. The pressure was maintained at the maximum for twenty minutes, and the total period of the test was about 2½ hours. The cylinders were then measured and found to be unaltered in size, and the following results were obtained in the subsequent tests :

	Tensile stress lb. per sq. in.	Scleroscope hardness
Aluminium	14,300 ...	6·5
Aluminium-copper alloy ...	27,300 ...	24·0

In the case of the alloy the threads were stripped at the stress specified, and the specimen was unbroken. Similar experiments at 40° C., using kerosene alone as the transmitting medium, gave a similar result, except for a slight increase of tenacity, and no alteration in structure was observed. These results contradict those of Hanriot, who found a 30 per cent. increase of ball-hardness in the case of aluminium under a hydrostatic pressure lower than the above. Bridgman directs attention to the fact that Hanriot used vaseline to transmit the pressure, and that this freezes hard under pressure, so that at the higher pressures the stress applied was not hydrostatic. This explanation is plausible. Prof. Jeffries concludes from these and other tests that the hardness of metals cannot be increased without permanent deformations unless such an increase in hardness is due to an allotropic change. The latter might, of course, cause either an increase or a decrease in hardness. As all Hanriot's results pointed to an increase of hardness it is probable that there was slight permanent deformation which he did not detect, and that this was the immediate cause of the increase.

In spite of the large number of researches which have been carried out, both on the purely scientific and technical aspects of the annealing of work-hardened metals and alloys, the subject still presents features which require more detailed investigation than they have yet received. The laws of annealing are considerably more complicated than the early investigators suspected. Especially does this apply to the first effects liable to be produced by heating. That in certain cases a hardening of the metal or alloy is produced, as measured by the tensile and ball-hardness

tests, must be regarded as established by the work of Charpy, Bengough and Hudson, Mathewson and Phillips and Thompson. Moreover, according to Howe, the first effect of slight heating in the case of iron may be either a softening or a hardening, depending on the intensity of the previous deformation, and in his view at least two agencies are at work in producing these results.

Prof. Carpenter and Mr. Taverner, of the Royal School of Mines, have investigated the way in which the tenacity of cold-worked aluminium of one particular degree of hardness is affected after the application of heat at various temperatures, and for periods of time very much longer than any that have been employed in any previous investigations. They find that the effect of heat at temperatures from 550°–300° C. inclusive is to cause a very rapid softening of the metal, and that *the same ultimate value of tenacity is reached in all cases.* Softening is complete in ninety-six hours, and nearly the whole of this occurs in the first hour of the test. At 250° C. the rate of softening, while still considerable, is much less rapid. Between 600 and 800 hours are required for complete softening, and here also the same ultimate value of tenacity is reached as at higher temperatures.

From 200° to 100° C. inclusive the rate of softening is slow, and as the temperature of 100° is approached, very slow. The actual sequence of changes can be classified conveniently under three heads:—(1) A comparatively rapid drop in tenacity in the first hour. (2) A tendency either to cease falling or actually to rise, such rise, in one case only, bringing the tenacity up to the original value. This period is in most cases completed in about 100 hours. (3) A relatively very slow fall of tenacity which is maintained on the whole steadily. These tests are still in progress. Assuming the present rate of loss of work-hardness to be maintained, and that the metal ultimately reaches the same tenacity as specimens tested at the higher temperatures, periods of the order of from one to three years will be required for completion. The fluctuations in the tenacity values referred to under (2) appear to be well established. Similar fluctuations in the rate of solution of hard-worked aluminium-sheet had previously been recorded by Seligman and Williams. The authors have also shown that the cold-rolled aluminium loses a considerable part of its work-hardness, in the temperature range 200° to 100° C., with scarcely any recovery of plasticity as judged by the elongation test.

H. C. H. C.

BRILLIANT FIREBALL OF OCTOBER 1.

METEORS of the largest type exhibit a propensity to appear in the twilight of early evening. On Monday, October 1, at 6.37 p.m., a splendid object of this class presented itself, moving slowly along an extended flight in a south to north direction. It was observed by a large number of persons in various parts of the country, and descriptions have been received from places so wide apart as Weston-super-Mare, Somerset, and the extreme North of England.

The accounts to hand are not, as usual in such cases, in perfect agreement, but some of them are excellent, and form a good basis for determining the meteor's real path in the air. The Rev. Canon J. M. Wilson observed the meteor from Worcester, and describes its flight as from 40° E. of N., alt. 15° to 18°, to 5° E. of N., and alt. 5°. Duration about 2½ sec. for the section of path he viewed. The Rev. J. Dunn, of Weston-super-Mare, describes the fireball as very brilliant, passing just above Capella. It was visible for five seconds; the head was some ten minutes of arc in diameter, and it threw off a short, reddish trail of sparks. Mr. H. J. Woodall saw the fireball from Oldham, and says it was in a direction 9° N. of E., and falling towards N. at an angle of 30°. The Rev. Watson Stratton, writing from Goole, Yorks, gives the path as from N.N.E., nearly as high as Polaris, to a point a few degrees W. of N., and about alt. 12°. Mr. Philip Burtt was at Penrith Station, and viewed the meteor as it descended and terminated its career just to the right of the moon. It was of a rich yellow colour. Mr. T. J. Moore reports from Doncaster that the direction was from E.N.E. to N.N.W., and that about one minute after the object had passed a very loud explosion was heard.

Many other accounts from Liverpool, Grantham (Notts), and other places might be quoted. Spectators agree as to the remarkable brilliancy of the object, and state that it aroused apprehension in cases where its real nature was not understood.

I have computed the real path as follows:—

Height at appearance, 56 miles over 4 miles E. of Boston, Lincolnshire.

Height at disappearance, 19 miles over 15 miles N. of Stanhope, Durham.

Length of luminous course, 160 miles.

Velocity per second, 23 miles.

Radiant point, 320°–22° in Capricornus.

The Rev. J. Dunn's estimate of the diameter would give the dimensions as half a mile, but this included the flaming effect and glare. Probably the solid nucleus was not many inches in diameter. As to the sound heard at Doncaster, it came too quickly for it to have been a meteoric effect.

Another fireball was seen on September 23. It lit up the sky, and was directed from a radiant at about 322°–23°, and probably belonged to the same system as the more recent one of October 1. Observations of the latter are still coming in, and it may be found desirable slightly to alter the results above given. A second fireball was seen on the same night at 10.46. Its radiant appears to have been at 351°+2°, and its height seventy-six to forty-one miles.

W. F. DENNING.

THE TASK OF BRITISH AGRICULTURE.

THE speech of the President of the Board of Agriculture at Darlington on October 5 calls for the widest attention as an authoritative pronouncement on the present situation of British agriculture in relation to the need for increased food production. The exigencies of a long war have imposed upon the British farmer the duty, on one hand, of securing a greatly increased production of bread-corn and potatoes, and, on the other, of maintaining the supplies of milk and meat. The ideal placed before him by the Board of Agriculture in the first place is an increase of 3,000,000 acres under grain, potatoes, and roots, to be obtained partly from existing arable land and partly by ploughing up pasture. To secure this end the Government is prepared to help, and Mr. Prothero outlined how much has already been done in the way of guaranteed prices for corn, extension of credit facilities, supply of soldier and women labour, increased supplies and controlled prices of fertilisers, supply of horses, ploughs, and ploughmen, and further of mechanical tractors. Of the last-named 1500 are already at work, and it is hoped that by February next the number will have increased more than fourfold. A timely warning was given, however, that the tractor in its present stage of development must be regarded as the least efficient of ploughing implements, and should be used preferably for the lightest work.

On the question of the maintenance of the milk supply Mr. Prothero urged that with the reasonable

scale of prices fixed for milk and the efforts being made to secure reduced prices for feeding-stuffs and a preferential call upon supplies, the dairy farmer was being fairly treated, and should endeavour to surmount his difficulties by securing greater economy in the use of food and an increased average milk output per cow.

On the subject of beef production Mr. Prothero did not conceal his apprehension that the scale of prices fixed by the Food Controller for the winter would not only gravely imperil our meat supplies, but would even operate adversely against corn production. From his practical experience he was convinced that current prices left little margin of profit, if any, for the arable farmer, who feeds and fattens cattle for the winter market. A price of 60*s*. per cwt. live weight for stall-fed cattle puts a premium on grass as the cheapest form of cattle-feeding, and thus renders the farmer more reluctant than ever to plough up grass; it penalises stall-feeding on arable farms, and so tends to diminish the supply of manure for the needed corn crops. We are glad to see, therefore, the announcement in Wednesday's *Times* that the War Cabinet has conceded the appeal of the farmers for a revision of the scale of maximum prices fixed some months ago for home-killed beef for the Army. Under the sliding-scale of prices for live cattle, as originally announced, the price for home-killed beef fell from 74*s*. per live cwt. in September to 72*s*. in October, 67*s*. in November and December, and 60*s*. from January 1, 1918. It has now been decided that the November and December price of 67*s*. shall continue until July 1, 1918, and that the 60*s*. maximum shall then come into force for the rest of the year.

At the best, with the reduced supplies of feeding-stuffs, it will be difficult to avoid a serious shortage of meat in May and June next year. We must not be driven to slaughter more cows or veal calves; we cannot depend upon an increased import of meat; the only safeguard within our control is a reduction in our consumption of meat, and this must be pressed for more and more insistently. The eloquent appeal to farmers in the closing part of Mr. Prothero's speech will assuredly not fall on deaf ears, but it is equally necessary that the public shall realise their difficulties and extend to them the sympathy which no section of the community more rightly deserves.

CHEMICAL LABORATORY PORCELAIN.[1]

THE first attempts to make porcelain in Europe were undoubtedly in imitation of the Chinese porcelain imported into Europe by the Dutch, English, and French East India Companies about 1673.

Its beautiful whiteness, its thinness, its translucency, its close vitreous fracture, apart from, and also in conjunction with, its decoration, at once appealed to and obtained the admiration and emulation of the Europeans.

The story of the struggle in the attempt to reproduce it is not within the scope of this paper, but suffice it to say that it was accomplished in Germany by Bottcher about 1706–18, and in England by Cookworthy, of Plymouth, about 1767.

The one factory continued for the reason that not only were the products excellent, but the financial success was not the main object, while the other had to bear its own losses, and though there was considerable promise of success, the financial aspect of the undertaking was a complete failure. It is well, then, at the outset to note that we do not owe the origin of the porcelain to the Continental potters, but to the Chinese.

[1] Abridged from a paper read at the annual meeting of the Society of Chemical Industry, July 18–20, by Mr. Henry Watkin.

Chinese porcelain being at that time the only translucent pottery in existence, there can be no wonder about the admiration it called forth.

It cannot be surprising, then, that the English potters were very anxious to produce such a body, and if that object could be attained, the means by which it was achieved were secondary matters, and we find that instead of continuing the manufacture of hard-paste porcelain, they produced, about the end of the eighteenth century, (1) a beautiful white earthenware which for generations secured the market of the world, and made it possible to replace almost all other pottery for domestic purposes; (2) a translucent white porcelain similar to the Chinese, by the use of other materials and methods, equally beautiful, which for more than a century has held its own amongst all other porcelain productions, and is generally known as bone china.

The ceramic productions of the world as regards their bodies or paste, apart altogether from decorative effects, vary from goods made from the coarsest to the finest clays, through almost every variety of texture, by admixture of the natural clay with other materials, such as sand, flint, barytes, felspathic rock, etc. From these materials were produced at one end of the scale the cinerary urns of our great ancestors, and, at the other end, the excellent hard-paste porcelain which we are considering to-day.

The marvellous difference in the productions of the various peoples of the world may probably be explained by the general assertion that the potters have from the very earliest times worked with the materials they had at hand. The cinerary urns of the ancient Britons were made from natural clays.

The Staffordshire potters used, at first, natural clays, found cropping up simultaneously with the coal, and afterwards improved the colour and texture of the product by the addition of, first, fireclay, then Devon and Cornish clay, and calcined flint. Messrs. Eler Bros. used the red marl of the Burslem district for their fine red ware. Bottcher, of Germany, at first made red ware from local clays, etc., and afterwards porcelain from the white clays or kaolin, and pegmatite.

The Chinese for centuries had been working with their natural materials, kaolin and petuntze, and from these produced their fine porcelain. Some of these various clays naturally required a much greater heat than others to produce hard vitreous bodies.

These varying conditions with regard to materials to the hand of the potter, when means of communication were so restricted, necessarily involved very varied methods of manufacture. The materials differing so essentially from each other naturally required very varying degrees of heat necessary to bring to maturity.

The kaolin and petuntze used by the Chinese would require a much higher temperature to mature than the clays, etc., used in other countries at the time. The exact temperature would not be found at once, and in working out the same an observant potter could not fail to notice the changes taking place in the fired material in regard to vitrification, translucency, and finally distortion at the various temperatures. Thus in all probability, without any more scientific knowledge whatever than careful observation, the fine product of that time would be produced which even now (centuries later) is the object of our research.

While the Chinese were for centuries making the most suitable material in the world for chemical laboratory ware, they had no use for such, and consequently did not make it. It was only with the advance of scientific chemical knowledge in Europe that the need was felt for the various porcelain accessories that were then called into use.

It is not surprising, therefore, that Germany and France, having continued making the Chinese type of

porcelain, should have applied themselves to this particular demand, and while the English porcelain manufacturers were busy on their own particular class of porcelains they should have almost entirely secured the trade of the world in this branch.

With the cessation of the importation of Continental porcelain into this country came the call to the English potter, and, as might have been expected, it was not every manufacturer that would listen to the call; neither was it needful that he should.

There was no very tempting offer of any lucrative opening in the new business, and a potter must be more tempted by patriotism to his country, and a desire to meet its needs, than by immediate prospective financial success.

It is almost impossible to give a definition of chemical porcelain which could generally be regarded as entirely satisfactory. When first porcelain was introduced into Europe, its translucency was sufficient to differentiate it from all other ceramic productions of that period.

We have seen that in the attempts to produce a similar porcelain in Great Britain and on the Continent other kinds of translucent pottery were discovered, which are known under other names, such as bone china, soft-paste porcelain, etc., the first of which for more than a century has held its own amongst the finest productions of the world.

It is quite clear, then, that what was once the predominant and characteristic definition of Chinese and Continental hard-paste porcelain is so no longer, and translucency alone could never be regarded as the guarantee of chemical porcelain. Translucency is only one of the properties of porcelain, and that rather of beauty than utility, as evidenced by the fact that so much of the beautiful translucent porcelain of England has been found useless for the purposes we have in our minds at the moment.

More than 150 years' experience of the manufacture of hard-paste porcelain at the State-supported Royal Factory of Berlin, the experience of which was placed at the disposal of the porcelain trade of Germany, gave it a tremendous advantage over the English manufacturer. It was therefore no light task for an English manufacturer, *minus* that experience, under entirely different conditions, with all the models and moulds to prepare, to attempt the task. Some three or four English manufacturers, however, have attempted the same with very considerable success.

While I cannot speak with any degree of confidence in relation to the manufacture or supply of other factories than our own, I think I may safely say that there is now no very serious occasion to go abroad for any of the chemical porcelain accessories needed in this country.

In spite of all the difficulties surrounding the problem, English samples were in the hands of the dealers for testing purposes in November, 1914. On January 20, 1915, deliveries were commenced. The permanent success of the venture for all the firms concerned will depend upon the behaviour in use.

Doubtless demand will be made upon our manufacturers, from time to time, for very special articles, such as the condensing worms as shown in the Royal Berlin Catalogue, p. 107, but if our Government will behave towards British potters as Continental countries have done to theirs, such articles will be made by special assistance.

We cannot refrain from expressing a sense of satisfaction that something has already been done by making a grant of 10,000*l*. to the North Staffs. Technical School, Stoke-on-Trent, for experimental work in connection with hard-paste porcelain, and extensive scientific research work in that direction is being carried out under the superintendence of Dr. Mellor.

With regard to the future of the trade, it may be well to repeat that the English potters for two years now have supplied Great Britain with nearly all that has been needed for scientific work, as also for chemical processes in connection with the war. The cry, therefore, that it cannot be done is no longer admissible.

We may not at present have succeeded in making anything superior to the German production, but I venture to say that in much less time than chemical hard-paste porcelain has been manufactured our country will be making something superior.

Much will depend on conditions prevailing after the war as to the permanent success of the undertaking. That there will be a keen fight for the trade need scarcely be said. The Germans will not very willingly relinquish their hold upon a trade they have held so long. Other countries also will compete. France, Denmark, Japan, and Russia have already commenced to supply, and the *Engineer* says:—"Like this country, America, prior to the war, depended upon Germany for porcelain articles used in chemical work, and especially for laboratory work. Since the war the German supply has ceased, and much inconvenience was caused to chemists across the Atlantic. To-day, however, we learn that American pottery manufacturers are producing porcelain equal to any produced in Germany."

The aim of the English potter in relation to this matter should be not slavishly to copy the hard-paste porcelain, but rather to follow the method pursued in the past, viz. to produce his own particular type of porcelain; but in this case it should be a porcelain suited to the particular requirements. The occasion is ripe for the introduction of something better than anything yet produced, and whatever the slight difference as to the colour and the degree of translucency, the main endeavour should be to produce a porcelain that will fulfil the requirements demanded of it.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Rev. T. C. Fitzpatrick, president of Queens' College, who has held the office of Vice-Chancellor during the past two years, made, in accordance with the usual custom, an address to the Senate on vacating this office on the first day of the Michaelmas term. He referred to the loss which the University had sustained during the past academic year through the death of, amongst others, Mr. Charles Smith, master of Sidney Sussex College; Prof. T. McKenny Hughes, who had held the Woodwardian professorship since 1873; Dr. W. H. Besant, the oldest living Senior Wrangler; Dr. Keith Lucas, who lost his life by an aeroplane accident; and Mr. W. E. Hartley, first assistant at the Observatory, who was killed in the explosion on H.M.S. *Vanguard*. He reported that the work of all the departments of the University had been maintained during the past year, though the number of students had again decreased. There were in residence in the Michaelmas term of 1916 444 undergraduates, as against 825 in the Michaelmas term of 1915. The number of Cambridge men on service had increased to 14,450. The list of killed now numbered 1872, of wounded and missing 2622. The honours won numbered 2855, and included eight V.C.'s, 210 D.S.O.'s, and 729 M.C.'s. Besides those serving with the forces, many members of the electoral roll were engaged on war service of various kinds.

Among the reports approved by the Senate during the year was an amended report on degrees for research, including recommendations which were not in

the first report for the establishment of degrees of Litt.B. and Sc.B., and the shortening by one year of the period required to elapse before admission to a degree conferring membership of the Senate. It was pointed out that the question of research degrees was bound up with the question of the residence of students from other universities for a limited period, and that the needs of such students called for sympathetic and generous treatment by the University.

With regard to the Previous Examination, which had been the subject during the past year of no fewer than six reports, two of them dealing with the question of compulsory Greek, now under consideration by a reconstituted Previous Examination Syndicate, the Vice-Chancellor urged that it was time that the method of exemption from this examination should be simplified, and pointed out that this simplification was rendered the more easy as the various examining bodies had recently established examinations for certificates on common lines. Various educational bodies were asking for simplification, and one and all demanded the abolition of compulsory Greek. He hoped that one way in which the University would mark the conclusion of the war would be by asking of candidates for admission only whether they had had a sufficient education, and not as to whether they could qualify in particular subjects.

The Financial Board had reported that the estimated income of the Chest for 1917 was 20,400*l*., a decrease of 60 per cent. from the pre-war income, whilst the expenditure was estimated at 36,200*l*. The board in its report had indicated how the deficiency might be met. The financial position of the University was better than had been expected, but, even if the income of the University after the war reached the pre-war standard, it would be insufficient to meet the claims for future expenditure. Returns made by the Special Boards of Studies indicated that large increases in annual and capital expenditure must be expected if the University was to meet the claims that might be made upon it as a place of teaching and research. Contributions from the colleges to the Common University Fund to raise the statutable amount of 30,000*l*. had increased from 10¾ per cent. in 1915 to 12½ in 1917; this gave some indication of the effects of the war on the incomes of the colleges.

The new Vice-Chancellor, Dr. Shipley, master of Christ's College, was prevented by indisposition from being present at the Senate House, and was admitted at the lodge of Christ's College.

OXFORD.—The Herbert Spencer lecture will be delivered in English by Prof. Emile Boutroux on Saturday, October 20. The subject will be "The Relation between Thought and Action from the German and from the Classical Point of View."

The Rev. H. E. D. Blakiston, president of Trinity, has been appointed Vice-Chancellor for the ensuing year.

ST. ANDREWS.—Prof. D'Arcy W. Thompson, professor of natural history, University College, Dundee, has been appointed to the chair of natural history at St. Andrews, in succession to Prof. W. C. McIntosh, who has just retired.

AT University College (University of London) a course of six lectures on "Coals, Peats, and Some Oil Shales: their Origin, Structure, and Significance, Palæobotanical and Otherwise," will be given by Dr. Marie Stopes on Tuesdays from October 16 to November 21, at 3 p.m. The lectures will deal with microscopic evidence in some detail, and will be specially adapted to students of botany and geology, but are open to the general public interested in coal.

PROF. F. J. CHESHIRE, director of the Department of Technical Optics in the Imperial College of Science and Technology, South Kensington, S.W., has been appointed honorary head of the Technical Optics Department of the Northampton Polytechnic, Clerkenwell, in accordance with the schemes of the Board of Education and of the London County Council for the provision of instruction in technical optics. These schemes may now, therefore, be regarded as definitely and fully launched, and it is not too much to hope that in view of the careful consideration given to their elaboration their effect upon the training of present and future generations of optical workers will be an important factor in replacing the optical trade of this country in the leading position which it occupied until about the last quarter of the nineteenth century.

MR. T. LL. HUMBERSTONE, secretary of the committee of the Education Reform Council concerned with university education, writes with reference to the comment of our reviewer on the report of the council (NATURE, September 27, p. 61) that the section of the report dealing with universities "speaks too much from the London point of view." He urges that as the report deals only with questions of general interest, there is no peculiarly London aspect. Our reviewer points out in reply that the Universities of Oxford and Cambridge, as well as the newer provincial universities, were not strongly represented on the committee referred to, and he suggests that the statesmanlike policy to have adopted would have been to secure well-chosen representatives from these universities so as to obtain from them an adequate expression of the desirable and practicable reforms at their respective universities. Reforms at the various universities will, he believes, prove to be most salutary and productive when they arise from within, and the surest plan, even if more difficult of attainment, is to create the appropriate impetus at the universities themselves, rather than to attempt to impose changes from outside.

IN an address on organisation of business and the development of the resources of the British Empire at the opening of the School of Pharmacy of the Pharmaceutical Society, Lt.-Col. Harrison, C.M.G., expressed his opinion that one of the most important problems that civilisation has to solve is how to secure the economy and efficiency of thorough organisation of the production and distribution of commodities of all kinds. In pharmacy this organisation has been taking place but slowly, and it is essential that it should be undertaken without delay by pharmacists themselves. A curriculum of study should be made compulsory, and the scientific standard raised so that pharmacists may take the place to which they are entitled. The number of women entering pharmacy has been steadily increasing, especially since the outbreak of war, and they have been filling the places of men who have been called to the colours. While women make excellent students, they are too prone to yield to authority and are indisposed to make independent experiments on their own initiative, without which progress in science is difficult. Teachers of women students should, therefore, do their best to instil into their students the spirit of investigation and research, and to develop their faculty of criticism.

LAST week Lord Sydenham, presiding at a meeting of the Women's Indian Study Association, raised again the urgent question of the education of women in India. The results as disclosed at the census of 1911 are sufficiently deplorable. Only thirteen females per mille attain the low standard of literacy prescribed for the enumeration. Sir E. Gait, reviewing these figures, found some comfort in the consideration that the proportion of literates at the age period fifteen–twenty is

now much greater than at the higher ages. "Until recently, very little encouragement was given to females to keep up their previously acquired knowledge after marriage, and many soon forgot what they had learned at school. But the main reason no doubt is that at the present time education is spreading very rapidly amongst them, and the number which is being taught in the schools is very much larger than even a decade ago." Female education is checked by the seclusion of women in the higher classes and by the early age of marriage. The results of this prevailing ignorance are shown in the high death-rate among young women, due to want of fresh air, inefficient midwifery, hard work at the critical period of life, and neglect of girl babies due to hypergamy. As Miss Boyd, the secretary of the Women's University Settlement, Bombay, pointed out, the Indian woman in childbirth has less chance of life than a soldier on the battlefield. Lord Sydenham remarked that nothing had touched the Indian soldiers in France and Belgium more than seeing how the women helped the men in those countries. More active sympathy between English ladies in India towards their native sisters, leading to the establishment of women's clubs, zenana visiting, employment of Indian women in the medical and nursing professions, etc., is greatly to be desired. At the present time the way is open, without any violent disturbance of existing social conditions, to ameliorate the condition of women and children in our Indian Empire.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 24.—M. Camille Jordan in the chair.—G. **Sizes**: Practical modifications of the "law of resonance of sonorous bodies" and correction to the note on Chinese gongs.—M. **Travers**: A new separation of tin and tungsten in wolframs containing tin. The mineral is fused with sodium sulphite, the aqueous solution slightly acidified, and the impure stannous sulphide, which is free from tungsten, filtered off. The tungsten is determined in a separate sample, opening up with sodium sulphite fusion as before.—M. **Baudouin**: A new disease of *Clupea spratta*, caused by a parasitic Copepod, *Lernoeenicus sardinae*.—P. **Wintrebert**: The gastrula of *Scyllium canicula*.—L. **Lapicque**: The separation of bran and the food yield of wheat. The calorific value, and hence the food value, of bread increase with the amount of bran extracted in the process of milling, so that white bread is more nutritious than wholemeal bread. It is pointed out, however, that, taking into account the percentage of white flour obtained for a given weight of wheat, a higher nutritive value is obtained with a wholemeal bread, since white flour rejects about 28 per cent. of the wheat. The 85 per cent. extraction now practised in France appears to be beneficial.—G. A. **Le Roy**: The use of glucosates of lime in bread-making. Glucosates of lime may be employed with advantage from the points of view of taste and keeping power in the place of lime-water, for improving bread made from flour containing a high proportion of bran, such as the 85 per cent. extraction in current use.

BOOKS RECEIVED.

Histology of Medicinal Plants. By Prof. W. Mansfield. Pp. xi+305. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13s. 6d. net.

Manual for the Essence Industry. By E. Walter. Pp. iii+427. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 18s. 6d. net.

Practical Cheesemaking. By C. W. Walker-Tisdale and W. E. Woodnutt. Pp. 182. (London: Headley Bros., Ltd.) 4s. 6d. net.

Through Lapland with Skis and Reindeer, with some Account of Ancient Lapland and the Murman Coast. By F. H. Butler. Pp. xii+286+4 maps and illustrations. (London: T. Fisher Unwin, Ltd.) 12s. 6d. net.

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. xxxviii., fasc. 6. (Genève: Georg et Cie.) 25 francs.

The Road and the Inn. By J. J. Hissey. Pp. xviii+435+32 illustrations. (London: Macmillan and Co., Ltd.) 10s. net.

About Winchester College. By A. K. Cook. To which is prefixed De Collegio Wintoniensi. By R. Mathew. Pp. xvii+583. (London: Macmillan and Co., Ltd.) 18s. net.

DIARY OF SOCIETIES.

THURSDAY, OCTOBER 11.

OPTICAL SOCIETY, at 8.—The Grading of Carborundum for Optical Purposes: J. W. French.

TUESDAY, OCTOBER 16.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Testing and Standardisation of Motor Fuel: E. L. Lomax.

WEDNESDAY, OCTOBER 17.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Report on the Recent Foraminifera Dredged off the East Coast of Australia by W. B. Thornhill, H.M.S. *Dart*, Station 19 (May 14, 1895): H. Sidebottom.—Mounting and Preserving Marine Biological Specimens: F. Martin Duncan.

ENTOMOLOGICAL SOCIETY, at 8.

FRIDAY, OCTOBER 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—A Comparison of the Working Costs of the Principal Prime Movers: O. Wans.

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THURSDAY, OCTOBER 18, 1917.

RESEARCH AND THE STATE.

IT was remarked by Prof. W. J. Pope, in an address to which we referred last week, that if suitable provision had been made by the State for the pursuit of scientific research twenty years ago we should have been saved from the horrors of the present conflict. He asked why the Government did not then make the experiment which it has now undertaken by the establishment of a Department of Scientific and Industrial Research with an endowment of 1,000,000*l*. The answer to the question is that our statesmen have never had sufficient knowledge of science to understand its relation to national advancement or sufficient faith in scientific discovery to believe that provision for it would ultimately benefit the community both industrially and politically. The public mind has been awakened to the essential value of research in all progressive industries, and every manifesto recently issued by organisations concerned with the future development of British trade insists upon its importance. Principles which have been persistently urged in these columns by a couple of generations of scientific men are now being proclaimed from the housetops and are heard in the highways, with the result that our political leaders are beginning to follow them.

There is much reason for satisfaction at this change of front, even though it be at long last. The official attitude is now vastly different from that of the Lords Commissioners of H.M. Treasury in 1872, when the British Association asked for a grant of 150*l*. to complete the reduction of tidal observations upon which the association itself had expended four times that amount. Their Lordships, after giving "anxious attention" to the memorial, regretted that the sum required could not be appropriated out of the public funds of this sea-girt isle for tidal investigations, because, if the request were granted, "it would be impossible to refuse to contribute towards the numerous other objects which men of eminence may desire to treat scientifically." Such was the position of State support of science in England in 1872; and the example shows how much remained to be done to bring about the change represented by the establishment of the Department of Scientific and Industrial Research.

Prof. Pope asked why this department was not instituted by the State twenty years ago, but he should have said more than forty years, for one of the chief recommendations of the Royal Commission appointed in 1870 was that a State Council of Science, presided over by a Minister of Science, should be established. The Commission was appointed with the seventh Duke of Devonshire as chairman and Sir Norman Lockyer as secretary, while among other members were Huxley, Sir G. G. Stokes, and the first Lord Avebury. The whole position of science in the United Kingdom was surveyed in the volumes of the Report of the Commission issued from 1871 to 1875; and it was the unanimous opinion of the Commissioners that a special department of State should be entrusted with the duty of promoting the scientific interests of the country. The suggested Council of Science was not intended solely to look after the interests of purely scientific research, but to bring to scientific tests, and advise upon, all Government projects in which scientific principles are involved. The great majority of the witnesses examined upon this point were entirely in favour of the establishment of a Council and Minister of Science.

The decided conviction was also expressed by the Science Commission of 1870 that one of the most efficient methods by which the Government could further research in this country was by the establishment of public laboratories for the pursuit of investigations in connection with the varying and ever-multiplying departments of physics, chemistry, biology, and other branches of science. Even at that time great laboratories had been erected at Berlin, Leipzig, Bonn, Aix-la-Chapelle, Karlsruhe, Stuttgart, and other places at the expense of the State, and special provision had been made in them for original scientific research, while nothing of the kind was done in our own country; and thus the main sources of new trades and improvements in manufactures remained undeveloped. The view then taken, and not altogether unknown even at the present time, was that the more science was left to itself the better for it. Mr. Gladstone, indeed, termed the intervention of the State as "interference" with science, calculated to discourage individual exertion, and so obstruct discovery and progress. A completely different view was taken by Lord Salisbury, who, in his evidence before the Science Commission, remarked: "Research is unremunerative; but it is highly desirable that it be pursued, and therefore the community must be content that funds should be set aside to be given, without any immediate and calculable return in work, to those by whom the research is to be pursued."

We have waited more than forty years for this necessary endowment of research, and the country has lost incalculable millions because no statesman had sufficient foresight to take heed of the

warning and advice of scientific men at a time when profitable action was clearly indicated.

After the publication of the Report of the Science Commission the Government had no excuse for neglect to remedy the evils brought under its notice. It was remarked in NATURE of March 26, 1874: "If means are not forthwith taken to organise our public museums and institutions for scientific research and instruction on some intelligent system, to supplement their lamentable deficiencies, and make them as widely beneficial to the advancement of science in all its departments and conducive to the highest instruction of the public as they are calculated to be, it can no longer be set down to ignorance, but to an utter disregard of the highest welfare of the country. In this direction the Government has a chance of distinguishing itself and winning for itself an enduring and worthy popularity; let it lose no time in showing its wisdom by appointing a responsible Minister of Education, whose duty it will be to keep all our public scientific and educational institutions up to the highest pitch of efficiency, to re-organise them upon some common basis, and to see that the progress of research in all branches of science is not hampered by the want of adequate means for its pursuit."

It is scarcely necessary to remind readers of NATURE that though the case for national care of scientific research was stated as convincingly as it could be by the leaders of science forty years ago, politicians turned deaf ears to their pleadings. It is true that a grant of 1000*l.* for scientific investigations was included in the Estimates from 1855 to 1881, and that in 1876 a further grant of 4000*l.* was voted for the payment of personal allowances to men engaged in research, but this latter grant represented the whole response of the Government to the recommendations of the Royal Commission on Science. Since 1882 the grant of 1000*l.*, which was provided under the Vote for Learned Societies, has been discontinued, and that of 4000*l.* has remained unaltered, except that it is now administered by the Royal Society instead of by the Science and Art Department, to which it was originally allocated.

In 1894 the Council of the Royal Society asked H.M. Treasury to increase the amount of this grant for scientific investigations, but without success. Men of science were not sufficiently organised, or did not possess the necessary political power, to force the subject of provision for research upon the attention of successive Governments until the desired ends were achieved. The first attempt to awaken the public to a sense of national danger on account of neglect of the subject was made by Sir Norman Lockyer in his presidential address to the British Association in 1903. Then, as thirty years earlier in the Report of the Science Commission, a convincing case was presented for the State endowment of universities on a scale which would make our facilities for highest education and research comparable with those of our chief competitors. As a natural outcome of this appeal, the Treasury grant to universities and colleges in England and Wales was doubled in the following year, and further increased later, until it reached the present amount of about 200,000*l.* a year instead of the 28,500*l.* available in 1903. But even this increased subsidy is less than the ordinary annual State endowment of Berlin University alone, while the total of the Government subsidies to universities in Germany is as much as 1,500,000*l.*

It is clear, therefore, that, though much has been done, the nation must be prepared for a further increase of expenditure upon scientific and technological education and research if we are to make good our shortcomings in the past. Mr. Fisher, President of the Board of Education, speaking at Cardiff on October 10, said that the way to establish a strong and powerful university was to get great men, and that not a bad way to secure these was to pay them well. The opportunity has come to ensure that generous provision is made for such assistance to university work as well as to establish a system of education better than that enjoyed anywhere else in the civilised world; and it is the duty of all who believe in these factors of national progress to support the efforts now being made to strengthen them.

The work of the British Science Guild in these directions has been of great national advantage. Inaugurated in 1905 to convince the people "of the necessity of applying the methods of science to all branches of human endeavour, and thus to further the progress and increase the welfare of the Empire," the Guild has been in the forefront of all recent movements for promoting the development of education and industry by the application of scientific principles. Early in its history it directed attention to the need for increased provision for agricultural research, and presented a memorial on the subject to the Prime Minister. The Development Act of 1909 gave the means of supplying this need; and the result is that during the year 1914–15 the total amount distributed by the Board of Agriculture in the form of grants for agricultural education and research was 92,000*l.* instead of the 16,000*l.* available ten years ago. Another State endowment of research was provided for by the National Insurance Act of 1911,

and under this the sum now available for medical research amounts to about 55,000*l.* annually. There is finally the block grant of 1,000,000*l.* made to the Department of Scientific and Industrial Research, which has much the same functions as those of the Council of Science adumbrated by the Science Commission of 1870.

We have good reason to be satisfied that the importance of research which was urged by scientific advocates for so many years without effect is now being recognised by the State; and that the lead thus given is being followed by our manufacturers. What has now to be guarded against is the administration of the funds by executive officers who do not possess sufficient scientific knowledge to prepare promising schemes of work or have not that close sympathy with scientific aims which places the original investigator above all other men in national value. The managing head of every council or manufactory which depends upon progressive science for its maintenance and development should be an expert in science and not an administrator only. The official mind is unwilling to believe that broad scientific knowledge may be combined with administrative capacity; and the result is, as Prof. Pope pointed out in his address, the more a man knows of scientific subjects on which he is engaged in a Government department or industry, the less likely is he to be given charge of them. Whatever provision is made for research by the State or in private industries cannot produce the fullest advantage until this unreasonable principle of appointment has been abandoned and the power of action is placed in the hands of men who can draw up the plans of a scientific campaign, and be given the responsibility of carrying them to a successful conclusion. Until this military method is applied to the scientific services, no machinery provided can be used to its utmost efficiency.

BEETLES AND DRAGONFLIES.

(1) *The Fauna of British India, including Ceylon and Burma. Coleoptera. Rhynchophora: Curculionidae.* By Dr. Guy A. K. Marshall. Pp. xv + 367. *Coleoptera. Lamellicornia,* Part ii. *(Rutelinae, Desmonycinae, and Euchirinae).* By G. J. Arrow. Pp. xiii + 387 + plates v. (London: Taylor and Francis, 1916–17.) Price 15*s.* each vol.

(2) *The Biology of Dragonflies (Odonata or Paraneuroptera).* By R. J. Tillyard. ("Cambridge Zoological Series.") Pp. xii + 396. (Cambridge: At the University Press, 1917.) Price 15*s.* net.

(1) THE imposing series of monographs on the fauna of India, published under the authority of the Secretary of State, has been enriched by these two volumes now contributed on important groups of beetles by Dr. Marshall and Mr. Arrow respectively. The Curculionidæ, or weevils, are dominant insects in most parts of the world, often forcing themselves on the attention of mankind by the damage that they cause to vegetation. In the volume now issued Dr. Marshall gives a general introduction on the family with respect to structure, life-history, and habit, and deals systematically with the two extensive sub-families Brachyderinæ and Otiorrhynchinæ. In the introductory section there are clear descriptions with figures of those modifications of the jaws and body-skeleton that are of classificatory importance, and a brief account of larval and pupal structure, with illustrations of the early stages in three genera. Dr. Marshall comments on our lack of knowledge about the life-histories of the vast majority of these beetles; nevertheless, he has brought together much interesting information about the habits of various Indian species. It is not generally known, for example, that a white excretory substance which builds the cocoon of certain Larini in the pupal stage "forms an article of commerce in the East, being largely used both medicinally and as a food." The systematic part of the work contains careful diagnoses of 342 species, illustrated by means of a hundred excellent figures.

Mr. Arrow's volume is the second devoted to the large group of the Lamellicorns, which includes the conspicuous stag-beetles and chafers and the highly interesting dung-beetles. It deals with three sub-families of chafers, including the Rutelinæ, to which belongs the common British "garden chafer." Nearly four hundred Indian Rutelinæ are described; many of them are adorned with brilliant colours, and the appearance of these can be judged from a coloured plate. Four other plates give structural details of the male reproductive armature, the systematic value of which among insects is becoming increasingly recognised. Some of the genera have an enormous number of species; Mr. Arrow describes 181 different kinds of Anomala, but he wisely refrains from attempting to divide this huge genus on characters derived from the study of a local fauna even so extensive as the Indian, because such characters "invariably break down when applied to other species or faunas than those upon which they are founded." The Euchirinæ, with which the volume concludes, are large chafers which climb about on trees, feeding on sweet exudations by means of specially modified jaws; the males possess forelegs of abnormal length and puzzling structure.

(2) Dragonflies are among the most interesting of the smaller orders of insects, and accounts of their structure and life-history may be found in many general works on entomology. But never before has the group received such detailed and well-balanced treatment as Mr. Tillyard has given in the handy volume now published as one of the "Cambridge Zoological Series." Students of the anatomy and development of insects are much

indebted to him for providing in this convenient form a trustworthy guide to the external and internal structure of dragonflies at various stages of their life-histories. He knows the literature of the order well and furnishes a full bibliography, but much of the information in the book is due to his own careful studies, pursued first in England and afterwards in Australia, where he now resides.

The "mask," or modified labium, of the dragonfly larva is one of the most remarkable of predaceous organs. Mr. Tillyard supports the view that its lateral lobe is formed by the labial palp; in this he is probably right, but his use of the term "exopodite" for the palp is less justifiable, as it is very doubtful if the crustacean exopodite is represented at all in any insectan appendage. The adaptation of the larvæ to aquatic life is of much interest, and the various types of tracheal gills found among them receive especially full treatment, though the author does not fail to emphasise the imperfection of our knowledge of the physiology of the respiratory process. Perhaps the most abnormal organs possessed by dragonflies are the problematical sclerites on the second abdominal segment that form the genital armature; Mr. Tillyard supplies a clear description of these with original figures. Embryology is treated with relative brevity, but there are some welcome original observations on modes of egg-laying by various female dragonflies. The phylogeny of the Odonata is discussed with reference to extinct genera from the Coal Measures onwards, and there is a full chapter on geographical distribution, accompanied by a map. Mr. Tillyard does not disdain, like some modern students, to retain the classical "regions" which may be used so as to indicate important distributional facts, if the student remembers that they have no guarded land frontiers. Detailed systematic treatment is outside the scope of the book, but the characters of families and sub-families are sufficiently elucidated to set a collector profitably to work in any part of the world, while a synopsis of the British species is welcome to the home-keeping student. There are four plates and 188 text-figures, for the most part excellent both in draughtsmanship and reproduction; the representations of the complicated wing-nervurations that form such important characters for the classification of dragonflies deserve a special word of praise.

Even in these volumes echoes of the war are to be met with. Mr. Tillyard gratefully records how his manuscript and six sets of proofs have passed to and fro between Australia and Cambridge since July, 1915, "without the loss of a single item." Dr. Marshall and Mr. Arrow acknowledge the courtesy of various German students of beetles who, in the days of international scientific helpfulness, facilitated the examination of type-specimens. One trusts that such once friendly entomologists will be glad to know that their fellow-countrymen failed to destroy the results of Mr. Tillyard's prolonged and peaceful labours.

G. H. CARPENTER.

THE INDIVIDUAL IN SOCIETY.

Community: A Sociological Study, being an Attempt to set out the Nature and Fundamental Laws of Social Life. By Dr. R. M. MacIver. Pp. xv+437. (London: Macmillan and Co., Ltd., 1917.) Price 12s. net.

DR. R. M. MACIVER'S study of community is a plea for the validity and importance of the individual life. The meaning of society is found within the constituent members. Social and individual claims are complementary to each other. Individual autonomy is realisable only within society. The liberty of the self proves itself in the relation of the self with other selves; for freedom is but a means of life, and not life itself. Social order involves the adjustment of individual claims to each other. Communal life is characterised by reciprocal action, and the wonder of the universe is the essential harmony of personal values working in and through society.

In the development of social consciousness the movement is at once both broad and deep. By the strength of a common life we break down the barriers of race and nationality, to find that we have intensified our hold upon the things that serve the well-being of individuality.

The clear-cut opposition of life and environment, as popularly conceived, is false. Environment is but the external correlative without which life would be futile and meaningless. The relation of the two is essential. Change in either involves change in the other. For Dr. MacIver "life is that which feels and knows and wills, that for which values exist and which itself exists as value." It is a shaping force expressing itself in character, of which environment may be the occasion or stimulus, but not the source. The increasing control of the individual over environment is secured in the development of a social co-operation marked by intelligence. In the evolution of society, rational or purposive selection must ultimately replace "natural selection."

Dr. MacIver has given a fine and adequate analysis of the meaning of society. The willed relations of living beings are the primary social facts, and "the ultimate social laws are those which reveal the interrelations of the purposes of living beings, their conditions and their consequences."

Community is defined as an area of common life, with definite characteristics such as are given in traditions, customs, manners, modes of speech, etc. It may transcend the State, in that it is not territorially limited; it may exist without a State, as among the Eskimos. The State is "the fundamental association for the maintenance and development of social order." Society involves co-ordinated rights and obligations embodied in political law and enforced by communal power. Law is the primary instrument of the State; it operates irrespective of the individual will. The State, however, cannot directly affect the spiritual life of its members. It can only deal with ex-

ternal manifestations, and then but formally. But "community is the common life of beings who are guided essentially from within." It is "the world the spirit has made for itself."

One of the most important factors in the development of community is the right of free association. An association is "an organised form of social life within community." Community is greater than any or all of the associations to which it may give birth. Sociology is the science of community. Specific social sciences, such as economics and politics, are concerned with associational forms of life. Dr. MacIver urges that social science must free itself from the quantitative methods and formulæ proper to physical and biological science. For such methods cannot be applied to purposes, to thought, to personality, or to institutions—"ideal constructions without quantitative length or breadth"—the stuff of social science.

In his analysis of community the author insists that "society is nothing more than individuals associated and organised," and that "the quality of a society is the quality of its members." Society is but the individual in human relationship. It is not characterised by the unity which distinguishes the individual organism. An organism is a closed system, but "community is a matter of degree, with no set bounds." The unity given in community is spiritual and not organic.

Dr. MacIver incidentally criticises the definition of mind as "an organised system of mental or purposive forces"—given by Mr. W. M'Dougall in his little book on Psychology—as "totally inadequate," on the ground that it is a confusion of the construction with the nature of the forces that construct. The "collective mind," with which Mr. M'Dougall credits "every highly organised human society," is a gratuitous hypothesis. Minds in association may act differently from each in isolation; but even so, in association it is the individual mind that acts. Community cannot be greater either than the sum or the resultant of its "parts," for such "parts" have never existed separately *as* parts. Stress is laid on the value of personality in community; "in the service of personality alone are laws and institutions justified."

A serviceable discussion on the relation of will and interest—"the two polar factors of all human activity"—helps the reader to understand their place in the creation of community. Society is mind in relationship. Interest and will are the objective and subjective aspects of a vital unity. "The interests of men . . . are the source of all social activity, and the changes in their interests are the source of all social evolution." Community is simply wills in relation.

Within the limits of a brief notice justice cannot be done to the completeness of the author's analysis of interests, associational and institutional life, and the meaning of the State. But we may express our gratitude for so able and suggestive a plea for the value and importance of individual human personality in the life of community, a plea more deeply significant against the background of present-day happenings.

W. L. S.

OUR BOOKSHELF.

General Types of Superior Men: A Philosophico-psychological Study of Genius, Talent, and Philistinism in their Bearings upon Human Society and its Struggle for a Better Social Order. By Osias L. Schwarz. Pp. 435. (Boston, Mass.: R. G. Badger, n.d.) Price 2.50 dollars net.

THIS study of "Superior Men" is hailed in a preface by Jack London as "immortal" and 'epoch-making," "truly a revival of Socrates' fight against the shams and sophists who ever bend themselves to the dethronement of ethics and the instalment of the worship of Mammon." It is also introduced by Max Nordau as "teeming with ideas, but still more seething with feelings." "It is Isaiah holding forth on the structure of modern society and on the barrenness and wickedness of the souls of contemporary civilised men."

Whatever the book teems or seethes with, it is not with clear ideas. "Heredity means persistence and transmittal of old environmental influences, *i.e.* of the organism's reactions thereto, as long as the provocative environmental causes remain the same or vary very slightly, *i.e.* in details only." "Any character or trait consists of three parts: One is inherited; one is apparently due to variation, but is mostly due to the actualisation, liberation, or emergence in the child of an inherited latent parental trait, or *vice versa*; it may be due to the latentification or repression of a parental actual trait; the third part is really due to variation, *i.e.* to acquisition made under new circumstances."

The book is full of this sort of muddiness, and yet there is often, we willingly recognise, a striking suggestiveness, as in the comparative curves of development of average man, artist, man of science, and philosopher. The chief merit of the book is in its passionate insistence on the imperativeness of making the most of really superior men—the geniuses in the pursuit of the true, the beautiful, and the good. According to the author, the unpardonable sin is the Philistine's depreciation of what he knows to be genuine, or the pseudo-superior man's attempt to palm off a pinchbeck substitute for good gold.

Our Analytical Chemistry and its Future. By Dr. W. F. Hillebrand. Pp. 36. (New York: Columbia Univ. Press; London: Humphrey Milford, 1917.) Price 1s. 6d. net.

THIS Chandler lecture for 1916, though purposely restricted to the conditions existing in the United States, is largely applicable, *mutatis mutandis*, to the position of analytical chemistry in this country also. In the early days of chemistry, when there was need for accumulated observations on the

composition of all kinds of matter, the great chemists of the period were of necessity analysts, and the analytical branch of chemistry stood in high repute. Latterly there has been some neglect, and less fundamental knowledge of analysis has been demanded of chemists. This is partly due to the great development of organic chemistry and physical chemistry, which have held out better promise of new discoveries. The lecturer contends, however, that the field of research in analytical chemistry is by no means an exhausted one. He instances, in support of his opinion, the possibility of finding uses for the rarer elements, such as gallium and indium; the influence of minute quantities of elements on the properties of materials; and the importance of exact analytical methods in physico-chemical researches. A national institution of analytical chemistry is wanted, of high scientific authority and in touch with industry: the best conditions for establishing and maintaining such an institution are discussed by Dr. Hillebrand at some length. C. S.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Plated Teeth of Sheep.

I HAVE read with interest the letters from various correspondents in NATURE (vol. xcix., pp. 264, 284, and 306) and the abstract of Prof. Liversidge's paper (*ibid.*, p. 290). Since the latter paper was published, operating on a much larger sample than Prof. Liversidge had at his disposal, I have been able to make a complete quantitative analysis of the deposit, not only from the teeth of sheep, but also from those of oxen and of man, both of which in composition agree closely with that from the sheep. A full account of my investigations will shortly be published in the Proc. Linnean Society of New South Wales.

Some of the writers in NATURE attribute the deposit to iron pyrites, either derived direct from fragments of mineral occurring about the pastures, or formed by interaction of iron oxide with sulphates. It would be interesting to know if any of these correspondents have applied tests to prove the presence of iron sulphide. Under the conditions ruling in a sheep's mouth, the formation of iron sulphide from the oxide and a sulphate is quite impossible, nor could iron pyrites be caused to spread itself on, and adhere to, the teeth when chewed along with its food by the animal.

As indicated by Prof. Liversidge, the deposit consists mainly of calcium phosphate with organic matter. As a matter of fact, such deposits, commonly known as "tartar," are of very general occurrence, being found not only on the teeth of sheep, but also on those of all mammals, including marsupials, which I have examined. Sometimes the coating is in a very thin layer, and brown or black in colour, but it varies up to quite a heavy coating one-eighth of an inch or more in thickness. In the case of sheep it does not always present the metallic appearance which has been the cause of so much speculation; it is sometimes nacreous and sometimes chalky. In man it constitutes the "tartar," which is removed from the teeth by dentists in the operation of "scaling."

It is not derived from the food as such, or from any accidentally eaten mineral, but is a true salivary calculus, precisely analogous to the calculi so commonly occurring in the urinary tract, and is derived, probably entirely, from the saliva.

It is extremely unlikely that the deposit found in England differs from that occurring in Australia. I may say that I have handled and examined many hundreds of sheep's jaws, as well as those of other animals, in consignments of bones received at a large bone charcoal factory in Sydney, and in every case the deposit, when present, has been as above described. I have also on several occasions found good examples of the deposit on the teeth in sheep's heads purchased in retail shops. THOS. STEEL.

Sydney, N.S. Wales, August 8.

An Optical Phenomenon.

I HAVE never seen the following phenomenon described; perhaps a physiologist can give the explanation. If the eye is fixed on a stream of water for twenty or thirty seconds, and is then turned on to a fixed object, the part of the field of view that had previously been occupied by the stream appears to move in a contrary direction to that in which the water had been moving; the apparent motion slows down rapidly and ceases in from five to ten seconds. This is seen not only with lateral motion, but also with up-and-down motion, as when a stream is looked down on from a bridge. The phenomenon is perhaps best seen with running water, but it may be observed with other bodies in motion—a passing train, for instance. The effect is very curious, as only part of the field of view appears to move, and it is remarkable to see objects apparently in motion, yet not changing their position relatively to objects above or below.

C. J. P. CAVE.

Lynmouth, October 4.

The Fireball of October 1 last.

SINCE forwarding to you the results of a preliminary discussion of the observations of this fine object, a large amount of additional data has come to hand. A re-examination on the basis of forty-four reports shows that the heights of the fireball as given in my contribution to NATURE of October 11 are as nearly as possible correct. But the radiant point should be further N.E., and the position of the object over England was more probably from forty-five miles E. by N. of Hull to twelve miles S. by E. of Wolsingham, Durham.

There were evidently two fireballs on the same night, one at 6h. 37m., the other at 10h. 46m. (October 1), and they appear to have been both directed from a radiant point near the star γ Piscium. It was this radiant which furnished the brilliant detonating meteorite that fell in a field near Wigan on October 13, 1914. It has also yielded many large fireballs in September. W. F. DENNING.

44 Egerton Road, Bristol, October 12.

The Autumn Moon.

IN the attractive paper on "The Autumn Moon" in NATURE of September 27 Sir Geo. Greenhill refers to the mistakes of poor common folks, and of poets and painters even, when they deal with things astronomical. He instances Coleridge's reported intention (in the first draft of "Christabel") to seat a star within the horns of the crescent moon. The idea seems to have

bitten "S. T. C.," for in the "Ancient Mariner" we have the well-known lines:—

Till clomb above the eastern bar
The hornèd moon, with one bright star
Within the nether tip.

Dr. Geo. Macdonald had a lecture on the wondrous poem, which admirably suited his spiritual nature, in which he gave some explanation of this celestial prodigy, but at this distance I forget what it was. Perhaps some of your readers have more retentive memories.

ALEX. MACDONALD.

Durris, Aberdeen.

EQUATORIAL AFRICA TO-DAY.[1]

I HAVE seldom read a more interesting, easily assimilable, truthful book on modern Africa than this record of Mr. J. Du Plessis's recent journeys backwards and forwards across Equatorial Africa. Between 1913 and 1916 the missionary-author visited the Gold Coast and Ashanti, was on the outskirts of Dahomé, travelled through Lagos and Abeokuta to Hausaland, up the Benue to the Shari, explored the western Cameroons, visited a great deal of Belgian and French Congoland, of Uganda and British East Africa, passed from Congoland through Northern Rhodesia, and revisited Nyasaland and the Moçambique coast.

I have reviewed elsewhere the political and ethical aspects of the book; let me deal here with the light it may throw on the ethnology and zoology of West and Central Africa.

"The journey" (from the coast to Ashanti) "which occupied Sir Garnet Wolseley . . . four months was accomplished by us in a single day," writes Mr. Du Plessis, who travelled from Sekondi to Kumasi by rail. Nevertheless, the mass of the Gold Coast forests retain their former magnificent luxuriance of growth; and perhaps after the war they may be used as object-lessons in botany (like those of eastern Sierra Leone). Certainly our official world, especially our Treasury (which grudges the tiny allowance of money for finishing the Flora of Tropical Africa that the late Lord Salisbury ordained), overlooked the fact that those West African and Cameroons forests under the British flag are distinctly among the world's wonders, and, besides being striking in their splendour, are replete with wealth for commerce which we might turn into coin of the realm were we only as a nation better educated in the lore of the twentieth century. Yet Mr. Du Plessis was a little shocked at evidences of modernity when he saw the forest-dwellers roofing their huts with corrugated iron, and when one of them—in excellent English—inquired if he was a dentist, as he wanted a tooth stopped!

The author has much to say about the *real* "dangerous animals" of Africa, the insects that spread all manner of germ diseases. His remarks about the vicious and cunning tsetse-flies on the Gribingi River are distinctly interesting. He points out that, while the tsetse-conveyed sleeping sickness is being got well in hand, and even extinguished in French and Belgian Congoland, it is spreading fast and far in Nyasaland and the adjoining part of Northern Rhodesia. Unfortunately, too, in this direction the disease is more virulent and less curable than elsewhere. Apparently, also, it is now proved that the ordinary *Glossina morsitans* of South and East Africa, as well as the wicked *palpalis*, can convey the trypanosomes.

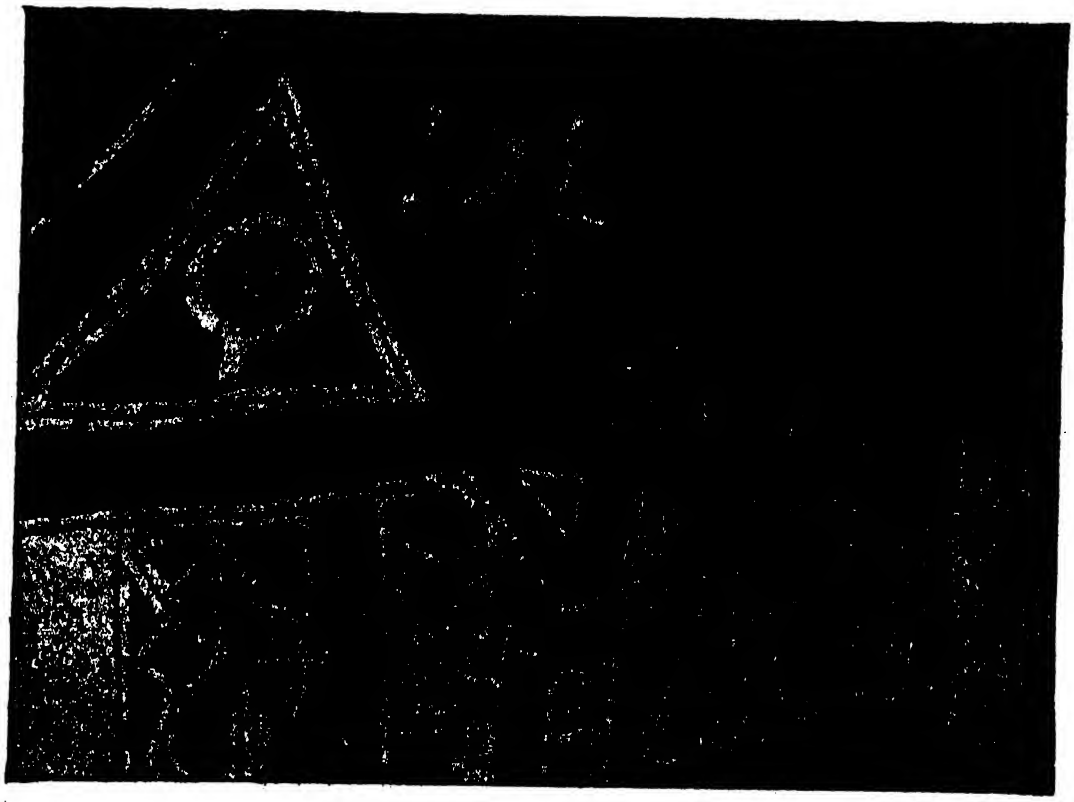

FIG. 1.—Mural ornamentation of the Basongi (Belgian Congo). From "Thrice through the Dark Continent.

Mr. Du Plessis tells us much about the interesting Munshi or Tivi people south of the central Benue. But he is mistaken in regarding their language as one that is quite isolated and almost unknown. It has recently been effectively illustrated—chiefly in the pages of the African Society's Journal, also in manuscripts that I am shortly publishing; and it stands out very clearly as a Semi-Bantu language with strong Bantu affinities, but otherwise connected as regards word-roots and syntax with other Semi-Bantu speech-forms in Nigeria and in the Cross River basin.

The author has something to say about the interesting Mundang tribe of the northern Cameroons, and his example of the language indicates that, like so many other forms of Sudanic speech, it possesses Bantu word-roots, though it can scarcely be called Semi-Bantu. There must be a strong underlying element of Semi-Bantu in many

[1] "Thrice through the Dark Continent: A Record of Journeyings across Africa during the Years 1913-16." By J. Du Plessis. Pp. viii+350. (London: Longmans, Green, and Co., 1917.) Price 14s. net.

of the negro languages between the Shari River on the east and the forests of West Africa, overlaid as these innumerable types of speech may be by other unrelated tongues, implanted at a later date in Equatorial Africa. We now know that the range of actual Semi-Bantu languages extends from the Lower and the Upper Gambia eastwards to the watershed of Lake Chad. Mr. Du Plessis lays stress on the ethnic importance of the A-zande, or Nyamnyam. Undoubtedly they will play a part in the future development of the western Bahr-al-Ghazal and the Mubangi-Wele basin as important as that of the Fula in Nigeria or the Mandingos of Senegambia.

Much information is given concerning the artistic aptitudes of various negro peoples, especially of the Nyamnyam, the Basonge (of central Congoland), and the A-nyanja of Nyasaland. A good deal of this desire to draw and paint and decorate is subsequent rather than prior to the establishment of European influence. Personally I believe that the negro may rise very high in the pictile arts, and that he has an inherent good taste and originality in design.

H. H. Johnston.

Fig. 2.—A specimen of native art (British Nyasaland). From "Thrice through the Dark Continent."

THE NUMBER AND DISTRIBUTION OF THE STARS.

An enumeration of the stars, classified according to their brightness and their position in the sky, must form a part of any general investigation into the nature of the stellar universe. It has long been one of the primary aims of astronomy to execute this enumeration. Considerable difficulties of a practical nature have to be faced in the course of the work, however, and only now do they appear to have been so far overcome as to enable a consensus of opinion to be formed amongst astronomers regarding the main features of the results. Whether visual or photographic methods are used, it is anything but easy to determine star magnitudes according to an absolute scale of light-ratio, and to maintain a constant zero point for the scale in widely separated regions of the sky.

The photometric work done at the Harvard and Mount Wilson observatories has greatly facilitated this task, and at these institutions, moreover, extensive schemes for the photographic survey of sample areas of the sky have recently been carried out. The Harvard plates have been measured, and a preliminary discussion of them made, at the Groningen Astronomical Laboratory; an account of this work,[1] and a brief note[2] upon that done at Mount Wilson, have lately appeared. In both cases the investigation has been extended to very faint stars (of magnitude 15·5 and 17·5 respectively); these are so numerous that counts of small sample areas, and the formation of statistical averages, afford the only practical means of attack upon the problem. The areas dealt with were among those

[1] Publications of the Astronomical Laboratory at Groningen. No. 27: "On the Number of Stars of Each Photographic Magnitude in Different Galactic Latitudes." By Dr. P. J. van Rhijn. (1917.)

[2] F. H. Seares, Proc. Nat. Acad. Sci., Washington, vol. iii., p. 217. (1917.)

selected by Prof. Kapteyn for his "Plan of Selected Areas" (1906), the number of regions for which data were available for preliminary discussion being sixty-five at Harvard and eighty-eight at Mount Wilson. Dr. van Rhijn's discussion is much the more detailed, Prof. Seares dealing only with the numbers of stars down to the *limiting* magnitude on each plate. The two investigations agree, however, in indicating a progressive increase in the concentration of the stars towards the galactic plane, as we proceed from brighter to fainter stars. Comparing star densities (*a*) in a belt of 20° on either side of the galaxy, and (*b*) in the caps of 50° radius round the galactic poles, the ratio is found to be 2·5 for stars brighter than $5^{m}\cdot0$ or $6^{m}\cdot0$, 5·5 for stars brighter than $16^{m}\cdot0$ (Harvard), and about 10 for those brighter than $17^{m}\cdot0$ (Mount Wilson); magnitudes are here reckoned on the revised Harvard photographic scale.

These results differ to some extent from those arrived at by earlier investigators, among whom the more recent are Pickering (1903), Kapteyn (1908), and Chapman and Melotte (1914). The differences, however, can now, in the main, be accounted for. The counts on which the first-mentioned work was based were incomplete in the richer regions of the sky, and the galactic condensation thus appeared to increase but little for the fainter stars. Kapteyn's memoir, on the contrary, gave values of the condensation which are larger than those mentioned above, but which are brought into fair agreement with them when his magnitude scale is corrected to the absolute scale determined more recently. Chapman and Melotte's investigation, which was photographic (thirty plates), and in many respects similar to the new Harvard-Groningen study, gave too small a galactic concentration for the faint stars (*i.e.* 3·1 at $16^{m}\cdot0$). Dr. van Rhijn points out that the method of reduction which they adopted was faulty, and would lead to too small a value; from a note in his memoir it appears that, after allowing for this error, Chapman and Melotte find that their data yield results in close accordance with his own.

It is of interest to note that Dr. van Rhijn's estimate of the total number of stars in the sky brighter than the 16th magnitude is approximately thirty-three millions. Also, if the law of increase in number which is obeyed down to this limit is used to obtain, by extrapolation, an estimate of the total number of stars of all magnitudes, the result is found to be 3360 millions; of these stars about half will be brighter than magnitude 25·5.

S. C.

ALCOHOL FUEL AND ENGINES.

THE special committee on "Alcohol Fuel and Engines" of the Australian Commonwealth Advisory Committee on Science and Industry has presented its first report. The need for such an investigation arises from the prospective shortage of supplies of mineral oils and the consequent high price of motor spirit.

There are three branches into which the inquiry divides, namely, the design and manufacture of the engine, the supply of the alcohol, and its denaturation. As the committee points out, there is no special difficulty with the engine; indeed, the use of alcohol, by permitting the compression ratio to be increased considerably, offers a prospect of some gain in thermal economy. Nor with a given engine need there be any loss of power, since the average calorific value per unit volume of a mixture of alcohol with the air necessary for its combustion is almost identical with the corresponding figure for petrol. Nevertheless, if alcohol be compared with petrol pound for pound, the latter has the advantage by some 50 per cent. A comparison gallon for gallon is more favourable to alcohol, but, whichever be adopted, alcohol needs to be at a lower unit price than petrol to be the more economical fuel.

Alcohol unfortunately suffers from the grave disadvantage that an engine will not "start up from the cold" with it, whereas its alternative rival, benzol, will easily enable this to be done on all but the very coldest days. Doubtless the possible use of benzol was outside the terms of the reference of this particular committee; but, had it not been so, the committee would certainly have had to point out that, although the alterations to the engine to suit it to alcohol as fuel are not considerable, the use of benzol enables the engine to be used without any alterations whatever.

The main difficulty seen by the committee is the question of supply. "It appears unlikely that any considerable quantity of alcohol can be manufactured in Australia from either waste or raw materials not at present utilised." The same remark applied to benzol before the war, but will it apply after? The quantity of benzol at present being produced for munitions is shrouded by the secrecy of war, but it is not out of place to speculate that when the need for vast munitions ceases a supply of benzol may be released for use in internal-combustion motors which will give a new aspect to the problem which this Australian committee is considering. The further reports of the committee will be looked forward to with interest.

NOTES.

AMONG the several matters which the deputation from the Joint Committee of Approved Societies and the Conference of the Amalgamated Society of Industrial Assurance brought before the Prime Minister, when he received it on October 11, not the least important was that with regard to the early establishment of a Ministry of Health. Mr. Lloyd George did not fail to recognise its importance, and in the reply which he made to the deputation showed that he was alive to the necessities of the case and understood the point of view of the deputation. In effect, the demand made was that, in connection with the establishment of the Ministry, the aim should be to give satisfaction to the national insurance organisations. It was suggested, too, that the one thing that must be done was to avoid allowing the Local Government Board to have any part in the work. The reason for asking this

was that the Board dealt with pauperism, and insured persons and trade unionists were opposed to it, would not have anything to do with it, and, in short, hated it. As a matter of fact, this was probably all that the deputation desired to say as to the Ministry of Health, except to assure the Prime Minister that the bodies concerned with national insurance were much more capable and deserving of the honour of being charged with the care of the nation's health. Except that he may possibly have been hinting that it was the fault of the Local Government Board that the laws as to public health were not satisfactory, and that there had been no drastic reform in connection with their administration, the Prime Minister said very little in praise or dispraise of this department. If he had words of praise for the national insurance bodies as public health administrators they did not appear in the newspaper reports of the proceedings. From these it would seem that perhaps the most important statement made by Mr. Lloyd George, so far as the Ministry of Health was concerned, was not one likely to bring much cheer to persons desirous of seeing an early settlement of the question. The Prime Minister made it clear that he regarded the matter as important, and that he saw the necessity for drastic alterations. Also he made it plain that he did not think this was the time to ask that changes should be made. It appears to be his view also that even if there is postponement and the country is asked to depend upon the existing arrangements for even a year or two, probably nothing very serious will happen.

UNDER the Representation of the People Bill now before the House of Commons, it is proposed to do away with the Livery vote of the City of London. A meeting was held at the Guildhall on October 15 to protest against this proposal. The Lord Mayor presided, and Lord Halsbury moved the following resolution, which was seconded by Major Rigg and carried by the meeting:—"That the Livery Companies of the City of London, in common hall assembled, earnestly protest against the attempt now disclosed, under the provisions of the Representation of the People Bill, to deprive the Livery of one of its most valued and long-established rights and privileges in exercising the Parliamentary franchise in the City of London; and against the injustice and wrong at such a moment in our history of having to defend these rights; and they further submit that the provisions in the Bill for preserving and extending the university franchise should include the retention of the ancient Livery franchise on educational grounds alone, apart from the other rights of the Livery to its retention. The Corporation and the Livery Companies have from time immemorial represented the founders and supporters of all grades of education, including faculties in science and literature in the universities to which the Bill rightly proposes to preserve or give the Parliamentary vote, and have cherished and supported all forms of manual, industrial, commercial, and scientific training, based upon and combined with such education. The City and Guilds Institute and the schools and colleges founded and still maintained in the City of London constitute in themselves an educational claim to the Parliamentary franchise, based on traditional influence, contemporary activity, and prestige as great as can be claimed for any kindred constituency, and the Livery make their appeal to Parliament to preserve to them rights they have well earned and ever exercised in the public interest." A strong case can certainly be made out for the retention of the Livery vote on the ground of the educational activities of the Livery Companies of the City of London. To the City and Guilds of London Institute alone these companies and the Corporation have contributed more than one million pounds, and they led the way in the provision of facilities for technical education in London. Their historical claims to Parliamentary representation are undoubted, and they are supported by beneficial national influence. Whatever reasons can be adduced for university representation can be applied with increased force to the Livery franchise; we hope, therefore, that the ancient right will be preserved.

ONE of the industries concerning which little is perhaps generally known, but upon which the steel, nonferrous metals, gas, glass, and other industries are absolutely dependent, is that which is concerned with the production of refractory materials. In the days before the war we were content to draw from abroad not only important supplies of raw materials, but also finished products. The new spirit in manufacturing, however, has led to a movement to make British industries particularly self-supporting in this direction. Mr. W. J. Jones, of the Ministry of Munitions, who is the president of the Ceramic Society, the autumn meeting of which concluded at Glasgow on October 3, in an address delivered to the Refractory Materials Section of that society, referred to the useful work which has been done by this section. He pointed out how the urgent needs of manufacturers for refractory materials have been met by the home industry, which, notwithstanding the depletion for national service of so many of the best men, has increased the output of coke-oven bricks by 100 per cent., of silica bricks by 60 per cent., of calcined dolomite by 80 per cent., and of firebrick by more than 20 per cent. In view of the fact that our manufacturing output must remain at a high level, both during the war period and after, Mr. Jones outlined the steps that should be taken to bring about the necessary increase in the supply of refractory materials of the right quality in order that they might withstand the high temperatures that would be certain to be applied, and the more severe conditions of service generally. What he asks is that there should be a closer combination between manufacturer and consumer, with the scientific investigator as a connecting link, and he urged upon all interested the desirability of at once giving consideration to a scheme of scientific research in which other societies are likely to cooperate. If the suggestions put forward by Mr. Jones commend themselves to the makers, and the necessary steps are taken to bring about their realisation, a great step forward will have been made by an industry which, although in a certain sense a subsidiary one, is intimately bound up with the future prosperity of our staple manufactures.

WE learn from the *Daily Telegraph* that President Poincaré has conferred the Legion of Honour upon Dr. John Cadman, C.M.G., professor of mining, University of Birmingham, in recognition of valuable services rendered by him in the cause of the Allies.

THE King has conferred the dignity of a peerage of the United Kingdom upon the Right Hon. Sir Francis Hopwood, vice-chairman of the Development Commission, and a member of the General Board and Executive Committee of the National Physical Laboratory.

WE regret to note that the *Engineer* for October 12 records the death of Mr. William Robert Sykes, the inventor of the lock-and-block system of railway signalling. Mr. Sykes died on October 2, at the age of seventy-seven years; he was responsible for the invention of many appliances relating to railway signalling.

THE death is announced in the *Engineer* for October 12 of Mr. Bernard Arkwright, chief of the engine works department at Elswick. Mr. Arkwright was born in 1861, and educated at Harrow, and he became assistant manager of the engine works belonging to Sir W. G.

Armstrong and Co., Ltd., at the early age of twenty-seven years. He was appointed a local director of the company in 1912, and was a member of the Institution of Civil Engineers and of the Institution of Mechanical Engineers. He occupied a prominent position in the North-East Coast Engineer Employers' Federation.

Dr. Addison, the Minister of Reconstruction, has appointed a committee to consider and report on questions connected with the supplies of raw materials which will be required by British industries for the purpose of restoring and developing trade after the termination of the war and the best means of securing and distributing supplies, due regard being had to the interests of the Allies. The committee, which will be known as the Central Committee on Supplies of Materials, consists of the following members:—Sir Clarendon Hyde (chairman), Sir H. Birchenough, K.C.M.G., Mr. Cecil Budd, Sir C. W. Fielding, K.B.E., Sir H. Babington Smith, K.C.B., Mr. W. Thorneycroft, and Mr. A. Weir. The secretary is Mr. J. F. Ronca, who should be addressed at the Ministry of Reconstruction, 2 Queen Anne's Gate Buildings, Westminster, S.W.1.

In discussing the development of the steel industry in Great Britain the leading article in *Engineering* for October 12 asks whether there are any signs during the last two years in the desire of our manufacturers to profit from scientific methods, and obtains a welcome affirmative from the recent autumn meetings of the Iron and Steel Institute and the Institute of Metals. There has always been great difficulty in getting British manufacturers to combine to solve collectively problems which affected all, and no better evidence that the "old order changeth" could be supplied than the report of Committee No. 1 on ore, fuels, and refractories, with which the Iron and Steel Institute opened its session. This report was compiled by Messrs. Guy Barrett (Ebbw Vale) and T. B. Rogerson (Glasgow), and gives in an admirably concise form the present state of our knowledge regarding the subjects dealt with, and received warm commendation from the members. In connection with the utilisation of low-grade ores, concentration will be required to convert these into high-grade ores, while briquetting will be necessary to make the product usable. Meanwhile there is money to be saved, the conservative estimate of the authors of the report being more than 5000*l.* per furnace-year.

The *Revue Scientifique* records the death on July 22 last of M. François Cyrille Grand'Eury, correspondant of the Institute of France in the section of botany. Born at Houdreville (Meurthe-et-Moselle) on March 9, 1839, Grand'Eury adopted the profession of a mining engineer, and spent his life in the coalfields. Early in his career he became interested in the fossil plants occurring in and around the coal-seams, and he continued until the end to make the best use of his unrivalled opportunities for observing the fossils in their natural position. He was thus able to make many important contributions to knowledge of the flora of the Carboniferous period, by correlating the roots, stems, foliage, and fruits, which were until then known only by isolated fragments and bore several distinct names. At the same time he made many striking observations in reference to the mode of origin of the coal-seams themselves. There are still differences of opinion as to some of his theories and deductions, but all are agreed as to the keenness of his insight into the problems before him and the success with which he helped to solve many of them. His numerous writings are beautifully illustrated, and will always be esteemed among the early classics of palæobotany. His memoir on the Carboniferous flora of the department of the Loire and the centre of France was published by the Academy of Sciences so long ago as 1876. His great work on the coal basin of the Gard appeared in 1890. At the time of his death he had begun the publication of "Recherches géobotaniques," in association with his only son, who has fallen in the war.

Lt.-Col. Godwin Austen writes with reference to the late Capt. G. F. T. Oakes, R.E.:—"I have only very recently heard of the death of this promising young engineer officer, which took place so long ago as July 15 last year at Ovilliers la Boiselle, when urging his men to complete a communication trench. Educated at Dulwich College, he entered Woolwich in September, 1900, and obtained his commission in December, 1901. Proceeding to India in 1904, he was appointed to the Indian Survey Department, and saw active service in the Abor Expedition of 1911–12, was mentioned in despatches, and received the medal and clasp. He did some fine work in this then unknown part of the Eastern Himalaya, in the great valley of the Dehang (the Tsanspu of Tibet, the Brahmaputra of Assam), carrying the triangulation and topography for 100 miles up the course of that great river to lat. 29° N., long. 95° E., including the great tributaries of the Siyom and Shimang on the right bank, with the Yamne on the left bank. The trigonometrical stations are lofty, up to 11,000 and 12,000 ft., covered with dense tropical forest, climatic and transport difficulties are great, and the people of the country wild; this survey he continued for another season after the troops had retired. Capt. Oakes did, besides, much for zoology, and I shall ever be grateful to him for the fine collection of land Mollusca he brought together; many rare species reached this country alive, and lived through the summer. This material, together with what was collected by Mr. S. W. Kemp, of the Indian Museum, during the Abor Expedition, shows that a very distinct molluscan fauna has developed in the Tsanspu valley, throwing much light on its ancient geological history and course. The Surveyor-General of India has lost a most promising assistant, and the Royal Engineers a brave officer, one who, on the return of peace, would have taken part in future pendulum survey operations in India, for which he was well fitted."

Rainfall and gunfire is the subject of a note by Dr. H. Deslandres, director of the Meudon Astrophysical Observatory, in the *Comptes rendus* of the Paris Academy of Sciences for August 27. A communication is included from the pen of M. C. Saint-Saëns, whose eminence in the world of music serves him as a passport into the realms of science. The composer relates that in the time of Louis Philippe the evening display of fireworks which terminated the national festival of the "Trois Glorieuses" in July at Paris had to be helped out by the discharge of ordnance with the view of increasing the noise, which was otherwise insufficient to satisfy the public; and that afterwards there was nearly always a heavy storm, although the afternoon was the usual time for such phenomena. M. Saint-Saëns is of opinion, however, that rain is only produced by gunfire in certain circumstances (which are not specified). Dr. Deslandres maintains that gunfire is never the primary cause of rainfall, but that it may serve to provoke, expedite, and increase precipitation. In the latter part of the note the author remarks that the statements of Pliny and Plutarch to the effect that great rains followed great battles in ancient times, long before the invention of explosives, may not be without foundation; he considers that the friction of javelins, arrows, stones, and other missiles may have been sufficient to effect an increased ionisation of the air, and thus by facilitating condensation to bring about premature or excessive rainfall. M. Angot, however, has recently pointed out that the lower

regions of the atmosphere are always highly ionised, and that it has yet to be proved that any addition of ions can excite premature condensation in unsaturated air (see NATURE, August 9, p. 467).

AN extraordinary feat of engineering is reported from America in the *Times* for October 10, under the heading "A Standardised Air-engine." Our American friends seem to have realised at the outset the inadvisability of using a number of engines of different design, and have sought to standardise an engine from the first. With this object in view, two eminent engineers, whose names have not yet been disclosed, were invited to meet and discuss the question of an all-American engine, embodying the best experience available on engine design. Manufacturers and consulting engineers have also co-operated, and, we are told, have patriotically given up trade secrets to assist in the new design. The work of designing and constructing a trial engine was completed in the amazingly short space of one month, and the new engine was run in Washington on Independence Day for the first time. The United States *Official Bulletin* of September 13 states that the tests have given complete satisfaction, and even goes so far as to say that the tests "justify the Government in accepting the engine as the best produced in any country." This is high praise indeed for an engine so rapidly designed and made, and motor engineers will await details of the design with considerable interest. Little is said in the *Official Bulletin* as to the details of the new engine. Standardisation is the keynote of the design, and the cylinders have been so arranged that engines having either eight or twelve cylinders can be built from the same standard parts. It is, of course, impossible to criticise the engine from a technical point of view with so little definite information, but the Americans are to be congratulated upon their early appreciation of the importance of a standard engine, and the immense amount of time in production and repair that can be saved by adopting such a design.

IN a circular letter received from the Decimal Association, and headed "The Breakdown of the Penny," a proposal is again put forward for the establishment of a system of decimal coinage based on the sovereign, or pound sterling, which would retain its present name and value, and would represent "1000 mils." It is pointed out that most of our existing coins down to and including the sixpenny-piece are available for incorporation in such a system without any alteration whatever in their respective values, and that the completion of the system by the division of the florin into 100 parts would involve only a slight modification in the values of our present bronze coins. The circular states that war-time conditions have completely changed the purchasing power of the penny, that the inflexibility of our subsidiary coinage has been one of the causes accentuating the high prices of daily necessities, which have been found to be the root of so much industrial unrest, and that the proposed changes will be of advantage to the industrial classes. Prices of halfpenny goods have in many instances been raised to a penny and those of penny goods to three-halfpence for lack of coins having values intermediate between our present halfpenny and penny and between the penny and three-halfpence. The provision of an enlarged range of low denomination coins in closely graduated steps would accordingly afford much relief to purchasers while enabling the seller to get a fair increase of price for his article. A table of the proposed decimal coinage, given in a pamphlet accompanying the circular, shows that the new coins introduced would be nickel pieces of 10, 5, and 2½ mils, and, if necessary, bronze pieces of 4, 2, and 1 mils.

THE annual report for 1916 of the Agricultural and Horticultural Research Station, Long Ashton, Bristol (the National Fruit and Cider Institute), forms an interesting record of work continued under great difficulties owing to depletion of staff. Cider and apple investigations form, as usual, the most prominent feature of the report, whilst several questions relating to black currants have also been studied. In addition to the staple research work of the station a number of questions which have arisen out of war-time conditions have been investigated, including experiments on the utilisation of cider apples and apple pomace as food for live stock and the substitution of glucose for cane-sugar in jam-making.

THE *Bulletin of the Imperial Institute* (vol. xv., No. 1) gives an account of the results of examination of *Ecdeiocolea monostachya* "leaves" from Western Australia, *Neoboutonia macrocalyx* timber from the East Africa Protectorate, and bark of *Brachystegia Randii* from Rhodesia, which have been investigated at the institute recently as sources of pulp for paper-making. The results on the whole were such as to indicate that these materials could be satisfactorily employed for the purpose. A further addition to the valuable information on oil-seeds supplied by the institute is given in articles on manketti nuts, babassu kernels, tucan nuts, and Paraguay kernels. In an article on the production of wheat in Egypt Mr. G. C. Dudgeon, of the Ministry of Agriculture, arrives at the conclusion that, except in years when the cotton crop is largely restricted in area, Egypt cannot grow enough cereals to supply completely her own necessities. Other reports, articles, and notes, covering a wide variety of subjects, contribute to make an interesting number.

IN his address to the Physical and Chemical Section of the Franklin Institute in January last Prof. Millikan, of the University of Chicago, dealt with one of the unsolved problems of modern physics,—the relation of the electron to the absorption and emission of radiation. The fact that short-wave radiation passes through matter without influencing more than one in a thousand billions of the atoms in the space traversed forces us to assume either that the energy of the radiation is not spread evenly over the wave front, or that there is some property of the atom which, while permitting it to take in energy from the radiation gradually, only admits of that energy being emitted in bundles or "quanta." The former alternative has been adopted by Thomson and by Einstein, but Millikan points out the objections to it, and is disposed to think the second alternative the more promising, although in its present state it leaves us in the dark as to the conditions which exist within the atom and the modification of them that the incident radiation brings about. Prof. Millikan's address is reproduced in the September number of the Journal of the institute.

Two 1½-metre comparators, complete with the necessary standards, have recently been completed and shipped for the Imperial Japanese Government. The object of these comparators is to enable the final standards of length, as used by our Japanese Allies, to be comparable with those in use at the National Physical Laboratory at Teddington. The supreme importance of accurate final standards, from the point of view of interchangeability of ordnance, is universally recognised. The standards themselves are divided in metric units, and consist of H-shaped bars of 58 per cent. nickel-steel with platinum-iridium divided surfaces. In their general method of construction, all

comparators consist of a heavy cast-iron base, on the back of which micrometer microscopes are fixed. The bars, to be compared, are mounted in a moving carriage, which is traversed to and fro beneath the microscopes, thus enabling *plus* and *minus* difference readings to be taken. In this case the moving carriage consists essentially of a double tank mounted on wheels. The two standards are carried on light beams in the inner tank, which beams are fitted with accurate levelling screws. The inner tank is filled with water, so as to maintain the standards at a constant temperature, whilst a complete system of thermometers enables the temperature accurately to be determined. The outer tank acts as a jacket to the inner. By filling the interspace with ice, or, alternatively, hot water, coefficients of expansion can be obtained to a high degree of accuracy. In the general design and in the supply of the detail fittings, the utmost precautions have been taken to eliminate small sources of error, and an accuracy of about $\pm 0.1\ \mu$ is anticipated after final erection. These instruments were constructed by the Société Genevoise, of 87 Victoria Street, London, and Geneva, to the specification of Mr. O. Paul Monckton.

THE September number of *La Science et la Vie* contains a description of the stereoradioscope invented by Major Lièvre, of the French Army Medical Corps. The principle of the apparatus is as follows. A body acted upon by the Röntgen rays emanating from two different sources distant from 6 to 10 centimetres from each other projects two parallel shadows on to the screen. If by a suitable arrangement the right eye is made to see only one of the images at the same time as the other image is seen by the left eye only, an observer will have a stereoscopic view of the radioscopic image. To dissociate the two images in this manner and render each visible to the corresponding eye, Major Lièvre has applied the principle of the persistence of luminous impressions on the retina. The apparatus itself consists of three essential parts superposed, viz. a double source of X-rays underneath, followed by the usual screen, then a sighting device provided with a shutter and a commutator. The commutator serves the purpose of operating one of the X-ray tubes simultaneously with the uncovering of one of the eyepieces, and of shutting off the other X-ray source and closing the shutter of the other eyepiece. The device, which has been adopted by the French Army, has the advantage of great mechanical simplicity and ease of application.

THE problem of the landing of an aeroplane in the shortest distance and with the minimum of shock is a very important one in aviation, especially with the advent of the heavier machines of the bombing type. In a very interesting article in the September number of *La Science et la Vie* M. Jean Fontanges deals with the question, and describes the systems of landing carriage employed on various French and German machines. The type of carriage provided with skids only is now practically obsolete, the most usual pattern consisting either of wheels alone, or wheels in conjunction with skids, or a rear crutch. The centre or supporting wheels have to be built on a high-strength framework (usually of steel tubing), with (smaller) front wheels to prevent the machine landing nose down. Some of the types are provided with brakes the wheels, to give quicker landing. Mention is made of the Paul Schmitt biplane, which is provided with a device for altering the incidence of the wings and so reducing the speed of the machine prior to landing. The article also discusses the types of shock-absorber usually employed.

MR. G. BURTON BAKER contributes to the *Chemical News* for September 21 an interesting note on a colouring matter extracted from Wasahba wood. The latter has a specific gravity 1·214; it is difficult to work, being extremely hard and almost bony in texture. When the sawdust is extracted with hot alcohol a colourless solution is obtained which becomes a bright salmon-pink when treated with an alkali solution, the colour being discharged by acids. If the alcoholic extract is used side by side with a one per cent. solution of phenolphthalein in the titration of ammonia, potassium hydroxide, and sodium hydroxide solutions with hydrochloric acid, the same result is obtained in the case of potassium hydroxide as with phenolphthalein, whilst with ammonia and sodium hydroxide the results were approximately the same. Concordant results could not be obtained when sodium, potassium, and ammonium carbonates were the alkalis employed. Further, the red alkaline solution will act as a dye, staining white pine quite deeply.

THE issue of *Engineering* for September 21 contains an account of the hydraulic power undertakings connected with the town of Barcelona and its electric supply. Under the control of the Barcelona Traction, Light, and Power Co. there has been inaugurated a threefold development of the hydraulic resources of the adjacent country. Power accessible to the extent of 60,000 h.p., under a head of 164 ft., is already obtained from the river Segre, from Lerida downwards for a distance of 18½ miles. By the formation of a dam, 262 ft. high, a reservoir has been formed on the river Noguera Pallaresa, giving a head of 492 ft., from which two power stations of 50,000 and 60,000 h.p. respectively are supplied. The river Ebro is to yield the third quota, a dam 1378 ft. long and 197 ft. high being contemplated, and this will enable its power station to develop no fewer than 300,000 h.p. The Noguera Pallaresa dam has only recently been completed. It impounds a volume of 6,909,000,000 cub. ft. It is constructed across the narrowest part of the valley and is curved to a radius of 984 ft. The dam is a gravity dam, with a volume of 9,500,000 cub. ft. The Tremp power-house is situated about half a mile below the dam, and has four turbines, which run under a maximum head of 229 ft. and a minimum head of 98 ft.

MR. HUMPHREY MILFORD, of the Oxford University Press, announces "Studies in the History and Method of Science," edited by C. Singer. It will contain the following contributions:—"The Scientific Views and Visions of St. Hildegarde," C. Singer; "Vitalism," Dr. J. W. Jenkinson; "A Study in Early Renaissance Anatomy," C. Singer; "The Blessing of Cramp Rings," R. Crawford; "Dr. John Weyer and the Witch Mania," E. T. Withington; "The 'Tractatus de Causis et Indiciis Morborum,' attributed to Maimonides," R. Levy; "Scientific Discovery and Logical Proof," F. S. Schiller. Mr. Milford will also publish "The Determination of Farming Costs," by C. S. Orwin.

THE October list of Publishers' Remainders of Mr. H. J. Glaisher, 55 Wigmore Street, W.1, is miscellaneous in character, and should be seen by those in search of books in new condition at low prices. Among the books likely to be of interest to readers of NATURE are Sir F. Galton's "Memories of My Life"; "The Life of Sir Joseph Banks"; "The Life and Work of Prof. C. Pritchard"; and "Eleanor Anne Ormerod: Autobiography and Correspondence," all of which are listed at a very low figure. The "Library of Useful Knowledge"—a series of shilling volumes—is offered at half-price.

OUR ASTRONOMICAL COLUMN.

THE NATURE OF SUN-SPOTS.—A useful summary of our knowledge of the phenomena presented by sunspots is given by the Rev. A. L. Cortie in *Science Progress* for October. A spot is regarded as an uprush of metallic vapours, which become cooled by rapid expansion, so that the spot appears dark by contrast with the bright solar surface. The umbra is considered to rise above the level of the photosphere, while the penumbra is built up by dark radial streams flowing from the umbra and seeking a level slightly lower than that of the photosphere. In round spots the penumbra is a shallow, saucer-like cavity, the lowest portion being due to the falling-in of the photospheric clouds caused by the initial uprush. This falling-in and heaping together of the photospheric clouds to fill the partial void produced by the ejection of the umbral vapours would account for the bright border which is generally seen to separate the umbra and penumbra. At a high level above the spot are the hydrogen flocculi, the rotation of which gives rise to the appearance of the solar vortices. Friction of the gyrating gases and vapours is considered competent to generate electric currents, and the accompanying magnetic fields which produce the Zeeman effects in the spectra of spots. Father Cortie considers it doubtful whether the umbra and penumbra of the spots themselves share this gyratory motion.

SOLAR PROMINENCES IN 1915.—An account of the observations of solar prominences made at Catania during 1915 has recently been given by Prof. Ricco, in continuation of the admirable series commenced by him in 1880 (*Mem., Soc. Spett. Italiani,* July–August, 1917). The number of days of observation was 168, and the total number of prominences exceeding 15″ in height was 1264, giving a mean daily frequency of 7·5. The activity in the northern hemisphere was the greater, the respective numbers being 677 and 587. The prominences were distributed almost symmetrically in the two hemispheres, few or none appearing in the polar and equatorial regions, while there were well-defined maxima in the zones $\pm 30°–35°$ and $\pm 50°–55°$. Twenty-four of the prominences exceeded 100″ in height, and one observed on May 5 reached 286″. The mean latitude of all the prominences was 38·65°, which was rather lower than for the preceding year. There was a marked increase of activity as compared with 1914.

A COMMERCIAL IRON OF UNUSUAL PURITY.

FOR some time past the Shelton Iron, Steel, and Coal Co., of Stoke-on-Trent, has been manufacturing a commercial iron of unusual purity in the basic open-hearth furnace. This iron is guaranteed to be 99·84 per cent. pure, and has been placed on the market under the trade name "Armco Iron." It differs from wrought-iron in that it has been melted and cast, and thus contains much less slag, and from mild steel in that its carbon content is so low that no pearlite is present. It has been found, however, to possess a peculiar property which militates against its practical usefulness, viz. the property of a characteristic red-shortness, or brittleness, when subjected to mechanical treatment between certain limits of temperature. The reason for this peculiar behaviour, which is not shared by other forms of commercial iron and mild steel of high quality, has been investigated by Messrs. Brooke and Hunting, and their preliminary results were communicated in an interesting note to the recent meeting of the Iron and Steel Institute.

Very early in the history of the process it was found that this brittleness always appeared between certain fixed limits of temperature, which they place at from 900°–800° C.; that on heating the iron to well above Ac3, and allowing it to cool, brittleness appeared, first at about 900° C., and disappeared sharply at about 800° C.; and that above and below these temperatures the metal possessed an unusually high degree of ductility and malleability. In fact, they comment on its similarity when cold to copper in respect of malleability, thus emphasising also its resemblance to the electrolytic iron investigated in 1913 by Stead and Carpenter.

The authors then proceeded to carry out systematic experiments on specimens of the iron quenched from various temperatures. They determined the tensile properties, and examined its structure and the type of fracture. Most interesting and illuminating results were obtained with the photographic records. Quenched from temperatures above 1000° C., the structure was that of γ iron with "martensitic" markings. As the quenching temperature fell this appearance altered, and the "γ iron effect changed to a more definite ferrite form." The authors say that at about the Ar3 point a complete change occurred, the ferrite grains increased considerably in size, and at the junctions of many of the crystal boundaries a peculiar structure was observed which was "perfectly constant and always possessed the same characteristic . . . viz. a central structure more or less pearlitic and very clearly defined, surrounded by a space composed of ferrite, and the whole again surrounded by a definite boundary which connects up with adjacent crystal grains." This structure is clearly seen in the photographs published by the authors. They say that a very large number of experiments have been made, and that in every case this peculiar structure has appeared in exactly the same manner. On lowering the quenching temperature somewhat the structure gradually becomes less pronounced, and at just above [illegible] C. it ceases to exist. Below 800° C. it was never observed, and the structure was that of normal ferrite. The temperatures at which this material is precipitated and reabsorbed coincide so remarkably with the beginning and end of the zone of brittleness that a strong presumption has been established that herein lies the origin of the characteristic red-shortness of the iron. The authors suggest that it is a eutectoid, probably composed of iron carbide, phosphide, and sulphide, with possibly traces of manganese sulphide and ferrous oxide, and that it is thrown out of solution in a semi-liquid or plastic condition, causing the grains to be very loosely held together, and thus making the structure relatively weak. If the iron is quenched in the 900°–800° C. zone, no brittleness is observed in the static tests.

The authors have found that a sample of Swedish iron similar in purity to the above material also shows a brittle zone in the same temperature range, and that an iron containing carbon 0·06 per cent. and manganese 0·10 per cent. shows no brittleness when manufactured in the same way as "Armco" iron. At one stage of the investigation they were inclined to connect the appearance of the material with the existence of dissolved oxide, since in one set of experiments they found it difficult to reproduce the characteristic structure, and this coincided with a remarkable absence of spots of "oxide material." Samples of metal, however, taken from the bath, just before tapping, when it was known to be in a super-oxidised condition, gave only a normal amount of eutectoid structure. Again, when complete deoxidation was attempted it still appeared. There is no reason, therefore, for connecting it with the presence of an unusual amount of oxide, and the nature of the "eutectoid"

structure is still a matter of pure conjecture. It is to be hoped that the authors will investigate this aspect of the research, difficult though it will probably prove to be.

The authors entitled their paper "A Note on the Microstructure of Commercially Pure Iron between Ar3 and Ar2." Strictly speaking, this is not the case. Mr. P. Tucker, who took cooling and heating curves for them, found Ac3 at 888° C. and Ar3 at 874° C., and makes the significant statement that it was "practically impossible so far to determine the Ar2 point of this material even on the most delicate instruments." Now the new structural constituent is shown in the photographs at 899° C., *while the material was still in the γ range*—above Ar3. It does not appear, therefore, that the upper limit of brittleness coincides with the Ar3 change. Ar2 is normally found at about 765° C. in commercially pure irons. This is about 35° lower than the temperature at which the eutectoid structure disappeared. No iron has ever been found to give Ar2 at so high a temperature as 800° C., which is actually below that at which the new constituent vanishes. Neither, therefore, does the lower limit of brittleness coincide with the Ar2 change, assuming that it does exist, according to the evidence at present available.

H. C. H. CARPENTER.

RECENT RESEARCHES AT VESUVIUS.

PROF. ALESSANDRO MALLADRA, the successor of Mercalli at the Royal Vesuvian observatory, has published a number of papers, from 1912 onwards, on the volcanic manifestations and progressive changes in the great crater formed in 1906. It has been possible in recent years to descend, by hazardous paths, to the edge of the central funnel, 250 metres below the crater-edge, and valuable observations have been made on the gases emitted from the fumaroles. Prof. Malladra furnishes a well-illustrated summary of the conditions in 1914 in "Nel cratere del Vesuvio" (*Boll. reale Soc. Geografica*, 1914, p. 753). The gradual widening of the crater by the falling in of its cliffs is shown in plan in a paper, "Sulle modificazioni del Vesuvio dopo il 1906" (*ibid.*, p. 1237). The small aperture of 1900 is also here indicated, almost immediately over the pit that is now active. The volcano remained quiet, in a solfataric stage, for seven years after the enormous outburst of 1906; but a glowing funnel opened in the floor of the crater of explosion on July 5, 1913. Prof. Malladra was engaged in a hypsometrical survey on the cone a few hours after this outbreak ("Sui fenomeni consecutivi all' apertura della bocca 5 Luglio, 1913," *Rend. R. Accad. Sci. Fis. e Mat. di Napoli*, fasc. 11 and 12, 1914), and has recorded a true incandescence, accompanied by the emission of fresh scoriæ, specimens of which were collected on one of many later visits. The "yellow fumarole" in the crater gave a temperature-reading of 128° C. in 1911. In September, 1913, this had risen to 330°, and in October to 347°. During the collection of gases from this fumarole for analysis, water condensed, containing hydrochloric acid in the proportion of 0·21 grams per 100 c.c., and smelling strongly of sulphuretted hydrogen. The author points out that, following the arguments of Brun as to the possibility of the permeation of water into a heated mass from without, this water must be truly magmatic. He thus provides further evidence, in addition to that of Day and Shepherd, against Brun's main contention.

Prof. Malladra illustrates ("I Gas vulcanici e la Vegetazione," *Boll. Soc. Sismologica Ital.*, vol. xviii.) the acid gases of Vesuvius rolling in a dense cloud down the mountain slope. They deposit on the leaves and branches of the trees a white dust consisting of chlorides and sulphates of iron and the alkalies; and these anhydrous or slightly hydrated gases are easily recognisable to the experienced eye from the ordinary masses of water vapour. Like the descending clouds that brought death to Saint-Pierre and Morne Rouge, they consist of very finely divided solid matter and gas, and resemble the smoke of a conflagration. The caustic effect produces brown spots and decay in leaves, and experiments are in progress in the planting of bare parts of the Vesuvian slopes with Euonymus and with a bamboo, appropriately known as *Arundo Plinii*, which flourishes fairly upon Stromboli. Both these, it is hoped, will resist the acid emanations.

An investigation of the rainfall on Vesuvius, and of the distribution of snow on the variously heated areas near the vent ("La pioggia sul Vesuvio, 1863–1913," *ibid.*, vol. xviii.), contains an interesting passage on the snow-accumulations formed by the freezing of the vapour of the fumaroles.

G. A. J. C.

FUEL RESEARCH.[1]

IN its first report[2] the Board stated that it had in view two main lines of research: first, a survey and classification of the coal seams in the various mining districts by means of chemical and physical tests in the laboratory, and, secondly, an investigation of the practical problems which must be solved if any large proportion of the raw coal at present burned in its natural state is to be replaced by the various forms of fuel obtainable from coal by carbonisation and gasification processes.

When the previous report was written it was believed that the survey and classification of coal seams might be proceeded with in advance of the second line of inquiry; but further consideration has shown that from the practical point of view the two lines are so thoroughly interdependent that they can be most satisfactorily dealt with side by side. This view will be further developed after the position and prospects with regard to the second line of inquiry have been more fully explained.

In preparation for the organisation of the first line, however, an experimental study of standard methods for the examination of samples of coal in the laboratory has been made. Hitherto in the systematic examination of coals in the laboratory there has been no generally accepted low-temperature carbonisation test. In the survey and classification of coals for the purposes of the present inquiries a test of this kind is practically indispensable. Certain existing tests are designed to ascertain the suitability of coal for gas- or coke-making, but as both these methods of carbonisation are carried out at temperatures above 900° C. they give little or no direct information as to the behaviour of the coal when carbonised at 500° to 600° C.

As a result of experimental work carried out for the Board in the fuel laboratory of the Imperial College of Science and Technology, a test has now been elaborated which by direct weighing and measurement gives the yields of gas, oil, water, and carbonaceous residue which result from carbonisation at any definite temperature. The apparatus is simple and is so arranged that the progress of the distillation can be watched from start to finish. The products can be weighed or measured with reasonable accuracy, and any or all of them can, if desired, be submitted to further examination.

[1] Report (slightly abridged) of the Fuel Research Board on its Scheme of Research and on the Establishment of a Fuel Research Station. (Published for the Department of Scientific and Industrial Research by H.M. Stationery Office.) Price 2d. net.

[2] This report was not published.

With regard to the organisation which will ultimately be required in the principal coal-mining districts for the collection and registration of samples, the Board is glad to say that it has found every disposition on the part of the representatives of the coal-owners to co-operate in this work. It is not proposed to start any extensive organisation for this purpose until the preparations for the second line of inquiry are further advanced. The accumulation of large numbers of samples would serve no useful purpose at present, and would be decidedly inconvenient. It is certain that as soon as the arrangements for the examination and testing of samples are in working order it will be an easy matter to maintain the necessary supply of samples to keep the laboratories and the research station fully occupied.

In the first report the following statement with regard to the second line of inquiry was made:—

"The second of the proposed lines of inquiry has been led up to by a variety of influences during the past eight or ten years. Among these influences have been the demands for cheaper and more ample supplies of electrical energy, for home supplies of fuel oil for the Navy, of motor spirit for the Transport and Air Services, and last, though by no means least, for smokeless domestic fuel. This last has been brought about through the growth of public and municipal opinion on the subject of smoke prevention in cities and in industrial centres.

"The only development which would satisfy all these needs simultaneously would be the replacement of a large proportion of the raw coal which is at present burned in boilers, furnaces, and domestic fires, by manufactured fuels prepared from raw coal by submitting it to distillation.

"The greater part of the coal which is consumed in Great Britain is burned in its natural state as it comes from the mines. The question of the moment then is: To what extent can and ought the present use of raw coal to be replaced by the use of one or other of the various forms of fuel manufactured from coal—coke, briquettes, tar, oil, or gas? While there is already in the possession of experts a certain amount of knowledge and experience which might enable them to organise and direct schemes for the replacement of raw coal by manufactured fuel in particular directions and on a fairly large scale, no really comprehensive scheme can be formulated until certain perfectly definite problems in coal distillation have been solved.

"These problems can be solved only by carefully organised experiments on a working scale carried out under the conditions likely to arise in practice."

The gas retort and the coke oven have become highly developed appliances for the carbonisation of coal at temperatures ranging from 900° to 1200° C. In the former the primary object of the carbonisation is to obtain the maximum yield of *gas* suitable for domestic and industrial lighting and heating, while in the latter *coke* is regarded as the principal product. In both cases the by-products of the operation are of economic value, but are necessarily of secondary importance. In considering the broad question of the replacement of any considerable proportion of the coal which is at present being burned in its raw or natural state by manufactured forms of fuel, the part which may be played by high-temperature methods of carbonisation will need to be taken into account. For this purpose a great amount of experience is available, and trustworthy data on which to base the calculation of the economic possibilities are in existence.

The distillation of oil shales at low temperatures for the production of mineral oils, paraffin wax, and ammonia is a highly developed industry, but the oil shales are totally unlike coal in their nature and in the products which they yield, so that the experience gained in this industry, though undoubtedly valuable, is only indirectly useful so far as coal is concerned.

As regards the carbonisation of coal at low temperatures, there is no corresponding body of experience in existence, and there are very few properly accredited data available. Some work has been done by individual inventors and syndicates, and a certain amount of experience has been gained. While only portions of this experience have been disclosed, enough is known to justify the conclusion that much still remains to be done in devising the special forms of apparatus required for the economical carrying out of this type of carbonisation.

The way is clearly open for a serious attempt to determine whether an economical and efficient apparatus can be devised for the carbonisation of coal at low temperatures, and whether, by the use of such an apparatus, for the carbonisation of properly selected coals, products will be obtained of a collective value greater than that of the original coal *plus* the cost of carbonisation and handling. Obviously the evolution of an economical and efficient apparatus is at the root of the whole matter, for only after a thoroughly practical apparatus is available can trustworthy tests of various classes of coal be made and the economic possibilities of the method be fully weighed and considered.

The solution of these fundamental problems will supply a new base from which to attack questions like the following:—

(1) Can the thirty-five to forty million tons of raw coal which is used every year for domestic heating be wholly or partially replaced by smokeless fuel, solid and gaseous, prepared by the carbonisation of this coal?

(2) Can adequate supplies of fuel oil for the Navy be obtained by carbonisation of the coal which is at present used in its raw form for industrial and domestic purposes?

(3) Can supplies of town gas be obtained more economically and conveniently by methods of carbonisation and gasification other than those at present in use in gasworks?

(4) Can electric power be obtained more cheaply if the coal used for steam raising is first subjected to processes of carbonisation and gasification?

(5) Will the more scientific development of the preparation and use of fuel, which would be implied in the successful working out of the foregoing questions, enable the peat deposits of the United Kingdom to take a serious place as economic sources of fuel for industrial purposes?

(6) Can the use of gaseous fuel in industrial operations be forwarded by the development of more scientific methods of combustion in furnaces, muffles, and ovens used in metallurgical, ceramic, and chemical operations?

The answers to these questions will be obtained only by co-ordinated research carried out on the lines of a broad and well-considered scheme. The subjects to be dealt with are already attracting the attention of serious workers in the industries, and it is to be expected that solutions of some of the problems will be supplied by these workers. The Board sincerely hopes that this will be the case. It would regard it as a great misfortune if the establishment of a Government organisation for fuel research were to result in the discouragement or limitation in any way of the activities of outside workers or organisations. It ventures to hope rather that many of these workers will be disposed to welcome a national scheme of research, the aims of which are broad and yet definite, and in which the more specialised contributions from all sides will naturally take their place.

In considering new and extensive schemes of carbon-

isation it is necessary to bear in mind that outlets for all the products of carbonisation must be found. The gas, coke, and shale-oil industries are all of old standing, and each has had to develop outlets for its products by patient and continuous effort. No new carbonisation scheme can be justified economically if it can only live by poaching on the preserves of the existing industries. Even if an efficient method of low-temperature carbonisation is evolved, it will be valueless in the wider sense unless profitable outlets for all the important products can be developed. It is obvious that the Fuel Research Board, which is in official touch with the Admiralty, the Ministry of Munitions, the Board of Trade, and other public departments, is exceptionally placed for the furtherance of schemes which involve the finding of large outlets for products new and old. It is known, for instance, that the Admiralty attaches great importance to the development of supplies of fuel oil from home sources, so that it may be taken for granted that this requirement alone would absorb all the oil which could be produced by the carbonisation of tens of millions of tons of coal per annum. This fact alone gives an entirely new aspect to the extension of carbonisation in hitherto untried directions, but while it will undoubtedly help on the economic side of the problem, it in no way relieves the pressure on the technical side. In a way, moreover, it accentuates the problem now to be referred to, the profitable disposal of the coke or carbonaceous residue left when the volatile products are distilled from the coal. The percentage of coke obtained varies with the quality of the coal and the temperature at which it is carbonised, but it may be taken on the average that each ton of coal carbonised will give about 15 cwt. of coke. Thus to obtain one million tons of fuel oil for the Navy it would be necessary to carbonise twenty million tons of coal, and the coke produced would amount to fifteen million tons.

The disposal of this very large quantity of coke or char at a profitable price must be regarded as the vital question if low-temperature carbonisation is to be established on a sound economic basis. The research scheme must therefore include a very complete inquiry on three main lines:—

(1) The use and value of this coke for the direct firing of steam boilers.

(2) Its gasification in producers for the manufacture of low-grade fuel gas and the recovery of its nitrogen as ammonia.

(3) Its use for industrial and domestic heating either directly, as it comes from the retorts, or after its conversion into briquettes.

The second of these inquiries will involve the development of a special form of gas-producer and auxiliary plant if the best results are to be obtained from the coke. It will also involve the development of a system of boiler firing in which fuel gas of 130 B.T.U. can be burned at least as efficiently as coal, both as regards thermal efficiency and the effective evaporation per square foot of heating surface.

In all that concerns the preparation and use of special forms of fuel there are two distinct stages of development to be passed successfully. In the first stage apparatus and methods have to be evolved and tested until a practical standard of efficiency is reached. In the second stage the consumers of fuel must be induced to study the new apparatus and methods until they thoroughly understand and in the end adopt them. This second stage will be most readily passed if an expert staff trained at a fuel research station is available to undertake the education of those who desire to adopt the new methods and appliances.

The use of town gas as a fuel for industrial purposes has made great strides during the past few years, and a number of experts are to-day engaged on the design and adaptation of furnaces and apparatus for these purposes. The actual practice of gas-heating still lags a long way behind the ideals of economy and efficiency, and there is room for much useful experimental inquiry into principles and methods.

The use of the lower grades of fuel gas, though successfully carried out in certain directions, is very imperfectly understood in the majority of industries in which gas might be used for heating and power purposes. In this direction there is scope for much useful work, both in research and in the education of experts and consumers.

A single illustration may be given of the complicated inquiries which will have to be conducted before an answer can be given to what seems to be a simple question.

There is a very general belief among electrical experts that the future of British industry will be greatly affected by the cost at which power in bulk can be supplied in the form of electricity. It has been proposed, for instance, that large electrochemical works should be established in this country for the manufacture of products which in the past have been manufactured in parts of the world where cheap water-power is available. In this connection it has been suggested that the cost of producing power from coal in this country would be substantially reduced if instead of burning the coal directly under the steam boilers it were first subjected to carbonisation and gasification processes which, in addition to fuel gas, would yield valuable by-products. Plausible statements have been issued showing the enormous savings or profits which would accrue if schemes of this sort were adopted. Unfortunately, these estimates have generally been made on a very slender foundation of knowledge and experience. On the other hand, those who, by experience and practice, are best qualified to judge hesitate to prophesy as to what the economic result of a combined carbonisation and power generating scheme would be, but they agree that the interests at stake are so great that the question ought to be authoritatively answered once for all. But no answer can be accepted which is not founded on the complete working out of the scheme, no important step in the series of operations being omitted or slurred over. This series of operations will start from the mechanical preparation of the coal and its conversion into solid, liquid, and gaseous products by carbonisation. It will end with the delivery of a known weight of high-pressure steam under the conditions most favourable for power production by turbo-generators. In the proposed scheme of research it will be seen that the investigation of each of the steps involved in the above inquiry is provided for. Three, at least, of these steps involve pioneering work on an industrial scale, and the work may occupy a considerable time. The Board realises that it is possible that the net result of this particular inquiry may be to show that purely as a means of cheapening the cost of electric power, the use of carbonisation methods has not much to commend it, but that certain incidental advantages will justify its use in particular cases.

The Fuel Research Station.

The scheme of research which has been outlined in this report can be efficiently carried out only in a fuel research station designed and equipped for the purpose, in which operations on an industrial scale can be carried out under proper working conditions.

It is desirable that the station should be within easy reach of London, that there should be ample railway and other facilities for the transport of coal from all parts of the kingdom, that there should be ready means for

the disposal of the large quantities of coke, oil, and gas which would be produced in the regular course of experimental work, and that a supply of labour, skilled and unskilled, should be available. It was realised that these conditions could be fulfilled only by a site in the neighbourhood of a large gasworks, and some months ago the Director of Fuel Research approached Dr. Charles Carpenter on the subject. Dr. Carpenter is chairman of the South Metropolitan Gas Company, and he is a member of the Carbonisation Sub-Committee of the Coal Conservation Sub-Committee of the Reconstruction Committee, of which the Director is vice-chairman. Following this conference, Dr. Carpenter, on behalf of the board of the South Metropolitan Gas Company, made the following very generous offer to this Board:—(1) To lease to the Government at a peppercorn rent sufficient land at the East Greenwich gasworks for the erection of a research station; (2) to prepare drawings and specifications for this station on lines to be laid down by this Board, and to make contracts for its erection; (3) to give every facility for the transport of coal and other supplies to the station, and to take over at market prices the surplus products, gas, tar, liquor, and coke resulting from the operations at the station. After further conferences a suitable site was agreed upon. The proposed site is a strip of level ground about 250 ft. wide by 700 to 800 ft. long, situated on the main siding which connects the gasworks with the South-Eastern Railway and with access to an existing road.

The foregoing scheme of research is obviously not intended to cover the whole of the territory which is open for exploration to-day. Still less ought it to be regarded as setting any limits to the exploration of new territories in the future. The root idea of the scheme is that certain fundamental changes in the preparation and use of fuel which have been proposed are of such far-reaching importance that the solution of the technical and economic problems involved ought to take precedence of all other matters. This does not mean that other lines of research will be ignored, but only that the larger issues must be kept well to the front until definite solutions of those technical and economic problems can be given. Though no direct reference has been made to the preparation and use of fuels from oil shales, brown coals, and peat, it is obvious that experimental inquiries on these matters will naturally find a place in the developments of the present scheme.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The term has begun with a greatly depleted number of undergraduates. The entry of freshmen, which used to average nearly 1000, fell in 1914 to 550, in 1915 to 238, and last year to 150. The number for the present academical year is about 100. Some colleges have none. The American Rhodes scholars, who have hitherto helped to raise the numbers above the vanishing point, are now called up for military service. Among the men who are now coming into residence for the first time are some who, after service at the front, have been discharged on the ground of wounds or sickness.

On October 10 a memorial tablet was unveiled at Oxford, commemorating the life and work of Roger Bacon. The tablet has been fixed to the old wall of the city, dating from early in the thirteenth century, close to the site of the Grey Friars Church in the precincts of which Roger Bacon was buried. The church has long since disappeared, but the position of the burial ground, though not the exact spot of Bacon's grave, is known. After the celebration at Oxford in 1914 of the seven hundredth anniversary of Bacon's birth, it was thought fitting that in addition to the statue then erected in the University museum, a permanent and public memorial should be set up as near as possible to the site of the Franciscan friary in which Bacon passed so many years of his strenuous life. This has now been accomplished, and the prophecy uttered by the Elizabethan dramatist Greene, which was recalled by Prof. James Ward, of Cambridge, at the ceremony in 1914 (see NATURE, June 18, 1914, p. 406), has at length been virtually fulfilled. The Latin inscription on the tablet is as follows:—

ROGERUS BACON
Philosophus insignis Doctor Mirabilis
Qui methodo experimentali
Scientiae fines mirifice protulit
Post vitam longam strenuam indefessam
Prope hunc locum
Inter Franciscanos suos
In Christo obdormivit
A·S·MCCXCII.
+

THE College of Physicians and Surgeons, the Medical School of Columbia University, has decided to admit women on an equal standing with men. This step has been taken after long consideration, and has been hastened by a great change in woman's position in Europe since the outbreak of the great war. For many years past a large number of women have worked in the laboratories of the Department of Health of New York, and have done admirably. The laboratories in the hospitals, also, frequently employ women, and with the repeated disappearance of men owing to the draft and enlistments in the Medical Reserve Corps, many places will be vacant which can only be filled by women. The opening of the Columbia Medical School to women has been made possible by a gift of 10,000*l.* from Mr. G. W. Brackenridge, of San Antonio, Texas.

THE Glasgow libraries have taken a step in the right direction in publishing a detailed catalogue of all the works on aeronautics to be found on their shelves. The list is not a long one, owing to the lack of books upon the new science, but it is fairly complete, the most notable omission being the works of Eiffel, or the excellent English translation thereof by Mr. J. C. Hunsaker. The pioneer experimental work of Eiffel should certainly find a place in any aeronautical library pretending to completeness. The committee representing the public and other libraries in Glasgow announces that this aeronautical list is to be the first of a series dealing with special subjects, and that the second of the series will deal with the internal-combustion engine. Other libraries would do well to follow Glasgow's example, for the catalogues ordinarily issued are of very little use as reference lists for any particular subject, and the increasing number of technical readers has created a demand for a convenient means of reference to technical subjects.

A COPY has been received of the calendar for the present session of the Merchant Venturers' Technical College, in which the faculty of engineering of the University of Bristol is provided and maintained. Among the varied and comprehensive arrangements explained in the calendar we note the Bristol "sandwich" scheme of training for engineers. The method is optional. The total length of the course is five years, of which about half is spent in the University and the rest in a works. Fourteen months are spent in a works at the end of the first session, and these enable a student to return to the University better qualified to understand the theory of engineering and the laboratory work than if he had had no such experience. Two months of the third year and

the whole of the fifth year are also spent in a works. Some twenty-one important engineering firms in different parts of the country have already agreed to take part in the experiment, and a satisfactory trial of the plan is assured. Full details are given in the calendar as to the courses of study demanded of students desiring to graduate in engineering in the University of Bristol.

THE annual report for 1916 of the chief medical officer of the Board of Education is now available (Cd. 8746, price 1s. net). The report furnishes a record of the school medical service of the local education authorities in England and Wales carried out under the general direction of the Board of Education. Sir George Newman contributes an introduction to the report, in which he says the fact must be faced that in 1916, as in former years, the records show a large amount of ill-health, of bodily impairment, and of physical and mental defect. Of the six millions of children in attendance at school, medical inspection shows that many, though not specifically "feeble-minded," are so dull and backward mentally as to be unable to derive full benefit from schooling, that upwards of 10 per cent. of the whole are at a like disability on account of uncleanliness, and that 10 per cent. also are mal-nourished. A year ago a moderate computation yielded not fewer than a million children of school age (not children in school attendance) as being so physically or mentally defective or diseased as to be unable to derive reasonable benefit from the education which the State provides. Local education authorities do not yet understand the nature of the problem which presents itself in their areas. Each authority should have continually a clear view of the steps necessary from a medical point of view to secure the full value of the school medical service to every child of school age in its area. The irreducible minimum, Sir George states, which will yield the results the nation requires is as follows:—(1) That every child shall periodically come under direct medical and dental supervision, and if found defective shall be "followed up." (2) That every child found mal-nourished shall, somehow or other, be nourished; and every child found verminous shall, somehow or other, be cleansed. (3) That for every sick, diseased, or defective child skilled medical treatment shall be made available, either by the local education authority or otherwise. (4) That every child shall be educated in a well-ventilated schoolroom or classroom, or in some form of open-air schoolroom or classroom. (5) That every child shall have daily organised physical exercise of an appropriate character. (6) That no child of school age shall be employed for profit except under approved conditions. (7) That the school environment and the means of education shall be such as can in no case exert unfavourable or injurious influence on the health, growth, and development of the child.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 1.—M. Camille Jordan in the chair.—M. **Angelesco**: A method of summation of trigonometrical series.—W. **Sierpinski** and N. **Lusin**: A decomposition of an interval.—Q. **Majorana**; Experimental demonstration of the constancy of the velocity of light reflected by a mirror in motion.—C. **Benediks**: The thermo-electric effect by contraction in the case of mercury. The thermo-electric effect described by the author in an earlier paper may be regarded as the reversal of the Thomson effect. It is, however, open to the possible objection that the effect observed may be due to the non-homogeneity of the metal wire employed; a similar effect is now demonstrated with pure mercury, in which case this objection cannot apply.—M. **Siegbahn** and W. **Stenström**: The X-ray spectra of the isotopic elements. A comparison of the X-ray spectra of RaG and ordinary lead has proved their absolute identity.—P. **Dejean**: Martensite, troostite, sorbite. A discussion of the definition of these micrographic constituents of steels.—L. C. **Soula**: A new method of graphically recording in physiology. The method is based on the principle that if a battery, microphone, and solenoid are placed in circuit, and a magnet is put in the axis of the solenoid, any variation of resistance produced in the microphone by external pressures produces corresponding modifications of the magnetic field, and a piece of soft iron carrying a writing point placed before the magnet gives a record of the pressures.—V. **Galippe**: Parasitism in toxic seeds or seeds rich in essential oils. The presence of micro-organisms was found to be general in both classes of seeds.—Edm. **Sergent** and Et. **Sergent**: A new method for the destruction of mosquitoes by alternation of their breeding-grounds. The life of the larva of the mosquito in the Mediterranean climate is from sixteen to twenty-five days before the metamorphosis into the winged insect. In the case of a spring, around which a breeding-bed of mosquitoes is liable to form, it is sufficient to dig out two channels and every eight days to change the water from one to the other. During the week the soil dries and the larvæ die for want of water. This method has given excellent results in Algeria, requires slight supervision, and costs little.—G. **Bertrand**: The digestibility of bread and the best utilisation of wheat. A comparison of existing data for white bread (72 per cent. extraction), wholemeal bread (100 per cent. extraction), and the intermediate (85 per cent.), taking into consideration the calorific value of the digested portion and the feeding of farm animals on the wheat offal, leads to no definite conclusion from a theoretical point of view.—H. **Vincent**: Results of antityphoid vaccination in the armies during the war.—C. **Levaditi** and L. **Delrez**: The cutaneous origin of the streptococci found in war wounds.

NEW SOUTH WALES.

Royal Society, August 1.—H. G. **Smith**: The resin of the outer bark of *Melaleuca uncinata*. The author describes the resin which is the chief constituent in the outer bark of this Melaleuca. A piece of this outer bark, if ignited at one end, will continue to burn like a candle until entirely consumed, giving at the same time a considerable amount of black smoke. The inflammable material consists almost entirely of a resin, as only a very small amount of a vegetable wax, melting at 67°–68° C., was detected. It is a rare occurrence for a true resin to be obtained in quantity from any member of the natural order Myrtaceæ, and in only one previous instance does it appear that a Myrtaceous resin has been recorded. The resin, which is present in the outer bark of *M. uncinata* to the extent of 23 per cent., is of an orange-brown colour, semi-transparent, and very brittle. It is almost entirely soluble in alcohol, quite soluble in ether-alcohol, and very soluble in acetone. It is only slightly soluble in chloroform and benzene, and turpentine has little action upon it even on boiling. The acetone solution makes a splendid lacquer for brass, and is perhaps one of the best uses to which the resin could be economically put. The chief constituent of the resin is a resin acid, the formula of which is $C_{17}H_{24}O_4$. It melts at about 148°–150° C., and in alcoholic solution gives a deep-green colour and green precipitate with ferric chloride. The neutral bodies of the resin melt

at about 125°–130° C., are brittle, of a resinous nature, and do not give the green coloration with ferric chloride.

VICTORIA.

Royal Society, July 12.—Prof. W. A. Osborne, president, in the chair.—J. H. **Gatliff** and C. J. **Gabriel**: Additions to, and alterations in, the catalogue of the marine shells of Victoria. *Ischnochiton proteus*, Reeve, *I. atkinsoni*, Iredale and May, and *I.* (*Stenochiton*) *pallens*, Ashby, were recorded as Victorian species. Figures of *Dosinea grata*, Desh., from specimens compared with the British Museum type are given.—F. **Chapman**: New or little-known Victorian fossils in the National Museum. Part xxi.: Some Tertiary Cetacean remains. A fine example of the cranial rostrum of the ziphoid, *Mesoplodon compressus*, Huxley, sp., is described, together with another less perfect, both tending to prove the specific identity of the two examples described by Huxley and Owen respectively. A new species of Scaldicetus (*S. lodgei*) is described, which, as a Balcombian or Oligocene form, is the oldest recorded example of the genus. A well-preserved tooth referred to Stenochiton (*S. cudmorei*) is apparently the first discovery of this genus in the fossil state, from the Kalimnan, or Lower Pliocene, of Port Phillip.—H. J. **Grayson**: Description of a new engine for ruling diffraction gratings. The ruling engine differs from other machines in respect to the following:—The screw and ways of the ruling carriage lie in one axial plane. The screw thrust occupies a central position upon the machine bed, and the screw is free from any stress other than that due to a direct axial pull upon the nut which is connected with the ruling carriage by means of two steel rods lying parallel with the screw axis. All the bearing surfaces or ways of the machine are ground circular bars of steel or glass, the latter forming the ways of the diamond carriage. They are semi-polished and require no lubrication; the frictional resistance is therefore uniform and constant. The teeth of the ratchet wheels are ground and finished with diamond-charged cutters, by which means a high degree of accuracy is obtained and compensating devices are dispensed with. Gratings submitted to the Mount Wilson Observatory have been pronounced practically free from periodicity and diffused light. (This research was awarded the 1917 Syme prize for the most important work published in Australia during the preceding biennium.)

BOOKS RECEIVED.

Municipal Engineering Practice. By A. P. Folwell. Pp. xi+422. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s*. 6*d*. net.

The Industrial and Artistic Technology of Paint and Varnish. By A. H. Sabin. Second edition. Pp. x+473. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s*. 6*d*. net.

Elementary Mathematical Analysis. By Prof. J. W. Young and F. M. Morgan. Pp. xii+548. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 11*s*. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, February–July, 1917. Edited by R. M. Milne. Pp. 30. (London: Macmillan and Co., Ltd.) 1*s*. 3*d*. net.

Memoirs of the Geological Survey, Scotland. The Economic Geology of the Central Coalfield of Scotland. Description of Area II. By L. W. Hinxman and others. Pp. iv+92. (Edinburgh: H.M.S.O.; London: E. Stanford, Ltd., and others.) 4*s*. 6*d*. net.

The Quest for Truth (Swarthmore Lecture). By S. P. Thompson. Pp. 128. (London: Headley Bros., Ltd.) 1*s*.

Heat Drop Tables: H.P. Gauge Pressures. L.P. Absolute Pressures. Calculated by H. Moss from the Formulæ and Steam Tables of Prof. H. L. Callendar. Pp. 63. (London: E. Arnold.) 5*s*. net.

Education: Scientific and Humane. Edited by F. G. Kenyon. Pp. 32. (London: J. Murray.) 6*d*. net.

Amusements in Mathematics. By H. E. Dudeney. Pp. viii+258. (London: T. Nelson and Sons, Ltd.) 3*s*. 6*d*. net.

Letters concerning the War between an American and a Relative in Germany. March–June, 1915. Pp. 82. (New York: Privately printed.)

Greenhouses: Their Construction and Equipment. By W. J. Wright. Pp. xvi+269. (New York: Orange Judd Co.) 1.60 dollars.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—A Comparison of the Working Costs of the Principal Prime Movers: O. Wans.

TUESDAY, OCTOBER 23.

ZOOLOGICAL SOCIETY, at 5.30.—Present Knowledge of the Life-history of the Common Eel: C. Tate Regan.—A Hermaphrodite Dogfish: Miss Ruth C. Bamber.—Ant-like Spiders from Malaya: H. D. Badcock.

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THURSDAY, OCTOBER 25, 1917.

CHINSURA

A RETROSPECT OF MODERN BRITISH SCIENCE.

The Cambridge History of English Literature. Edited by Sir A. W. Ward and A. R. Waller. Vol. xiv., *The Nineteenth Century.* Pp. xii + 658. (Cambridge: At the University Press, 1916.) Price 9*s.* net.

THIS the concluding volume of the great history of English literature produced by the Cambridge University Press, on the "collective responsibility" of the Master of Peterhouse and Mr. A. R. Waller, of the same college, contains a chapter of nearly fifty pages devoted to the literature of science in the eighteenth and nineteenth centuries. For this chapter, science is scheduled in three bibliographies grouped under physics and mathematics, chemistry, and biology respectively. The chapter is accordingly given in sections with those headings. Mr. Rouse Ball contributes the section on physics and mathematics, Mr. Pattison Muir that on chemistry, and Dr. Shipley, Master of Christ's, that on biology.

The sections on physics and mathematics and on chemistry are disappointing, for different reasons in the two cases. The development of physical science in the nineteenth century, as it appears in scientific literature, is a most attractive subject for an essay. It began with the law of conservation of matter and the atomic theory; it found the law of conservation of energy in its middle course; and in the end offered us unlimited possibilities for new views of the physical universe in the story that radiation was made to tell, in its many forms, some new, some old. We are carried on to new ideas of the constitution of matter and the exploitation of the energy of atoms. Mr. Ball does not show us the reflection of this moving picture in the English literature of the century. After leading up to Whewell and the British Association, he gives us silhouettes of Faraday, de Morgan, Boole, Rowan Hamilton, Sylvester, Adams, Cayley, Henry Smith, Green, Stokes, Kelvin, and Maxwell, with passing shadows of a few other names. No one would suppose from reading the chapter that the great principle of the conservation of energy was a subject of lively discussion almost within the author's personal experience.

Nor among the achievements in physics of the nineteenth century is any place found for solar and stellar physics. Whewell would have taken a wider view of physics because it is still an inductive science. Mr. Ball's mental process is plain enough. "Faraday was recognised as an exceptional genius, and time has strengthened the recognition of his claim to distinction; but, in general, theoretical physics had, by now, become so closely connected with mathematics that it seemed hardly possible for anyone without mathematical knowledge to make further advances in its problems." It is a very limited science that can live on the "advancement of *its* problems." Physics had a very different kind of career in the nineteenth century. The new problems added by experiment are quite as impressive as the advancement of the old. For some reason not given, "with observational and practical astronomy we are not here concerned," and with astronomy go the other observational branches of physical science. So the name of Sabine does not appear, and Huggins is only accessible to the reader by a reference to Miss A. M. Clerke's books.

One other of Mr. Ball's sentences must be quoted. "Faraday had been brought up in humble circumstances, and his career is interesting as an illustration of the fact that, in England, no door is closed to genius." Surely that is a misreading of history. What one gathers from Faraday's career is that in all England there was just one door open to his genius, and he knocked at the right one. If he had knocked at the Cambridge door instead, or at any other door, he would have found thirty-nine articles, at least, in his way. Instead of sunny complacence at the perfection of our arrangements, the circumstance seems to suggest a shudder at a very narrow escape. No doubt Adams, Stokes, and Cayley would have gone on the even tenor of their way in any case; but the literature of science might have been quite different if Faraday had missed the unique opportunity afforded to him by Davy at the Royal Institution. How many Faradays have remained mute and inglorious because doors were closed does not appear in the literature of science.

The literature of chemistry is also disappointing, but for another reason; there are great names in the story which is skilfully woven by Mr. Pattison Muir, but how few! Priestley, Black, Dalton, Cavendish, Davy, Faraday, Alexander Williamson, Frankland, Graham. We can add Roscoe, Perkin, and Ramsay, who have passed away more recently. During a hundred and fifty years we seem always to have been able to produce a chemist of the highest distinction, but always in comparative isolation.

Dr. Shipley's contribution, in a style which is embroidered with gentle gossip, carries us through the botany of the eighteenth century, the establishment of public museums, of scientific societies, including the British Association, and of scientific journals, to the period of scientific exploration which gave Sir Joseph Banks his opportunity and culminated in the *Challenger* expedition, before he settles down to the biological literature of the nineteenth century. A rapid survey of the work of the leading geologists and zoologists, with a well-merited note on the contribution of Sir F. D. Godman, erroneously printed as Goodman, and Osbert Salvin, leads up to the doctrine of evolution, the origin of species, and the work of Darwin and Wallace and Huxley. The more recent developments are only lightly touched upon.

But there is much more in the volume that will interest men of science than the single chapter which is specifically devoted to the literature of science. The whole volume is full of interest. In Prof. Sorley's chapter on philosophers and in one

by Mr. F. A. Kirkpatrick on the literature of travel we meet a number of scientific names in circumstances in which physical and biological science find much of their primary impulse for research. Prof. J. W. Adamson contributes a most valuable chapter on the history of education; and, finally, a chapter on the changes in the language since the time of Shakespeare, by Mr. W. Murison, may be commended to all those who are interested, as all of us ought to be, in the literary exposition of scientific work.

THE RARER ELEMENTS.

Introduction to the Rarer Elements. By Dr. P. E. Browning. Fourth edition, thoroughly revised. Pp. 250. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 7s. net.

WE are pleased to find that in spite of the unrest of the present time it has been possible to publish a fourth edition of the above well-known work. Browning's Introduction to the study of the rarer elements was first published in 1903 as a hand-book for the use of students. The work was successful from the first; a second edition appeared in 1908, and a third in 1912. Since then many new facts have been established, and the present issue has been revised and brought up to date, forming a valuable book of reference for practically all that is known about the history, sources, and properties of the rarer elements; numerous reactions are included that will help in the separation and analysis of these little-known bodies.

The general plan of the work is to give particulars of the discovery, occurrence, extraction, and properties of each element, etc., and to conclude with some practical laboratory work; although the author disclaims any attempt at exhaustive treatment, the student will find much valuable information in its 250 pages. It may be a little startling to the English reader to find in the index to the literature of the subject that, out of twenty-five references quoted, fifteen are American, seven German, two French, and one British! It is only fair, however, to note that most of the American references are from the Smithsonian Collection of Miscellaneous Papers.

All the rarer elements, including the rare earths and the rare gases of the atmosphere, are detailed, and a special chapter is devoted to the radio-elements. This latter section, contributed by Prof. B. B. Boltwood, is brief and is confined to the well-established data and reactions of these interesting bodies, and their position in the periodic table. The significance of atomic numbers and the theory of isotopes are also discussed.

In this chapter a good deal of new matter is introduced; among other things it is stated that "the chief source of radium has been the minerals containing a higher proportion of uranium, principally carnotite, and the present supply has been largely obtained from the carnotite ores of south-western Colorado." We rather hesitate to endorse this. Carnotite is a uranium-potassium-vanadate, and authoritative analyses of picked specimens give about 60 per cent. uranium; but the records of the Bureau of Standards, Washington, show that the commercial ores that are being worked do not contain much more than 2 per cent. uranium. On the other hand, the pitchblende deposits of St. Joachimsthal give 60 per cent. to 80 per cent. U_3O_8, and those from Cornwall and other localities are of the same character.

In the section devoted to spectroscopic reactions, a spectrogram is given of certain gallium and iridium products; this illustration may be of interest from the point of view of pure research, but as a spectrum reproduction it falls very short of what it is possible to do at the present day. The same must be said of the set of six examples of the absorption spectra, of didymium, erbium, etc.; some of these have scales of wave-length that are difficult to read, others are so bad that their value is quite lost, while the erbia series has no scale at all, and in the table of spark spectra of sixteen elements an arbitrary scale is used—this scale could have been given in Ångström units, which would have added greatly to its value. The list of wave-lengths of the dominant arc and spark lines of the elements is a very good feature and of real value.

A short chapter is devoted to "some technical applications," and many of the more prominent uses to which the rarer elements have been applied are described. This is an exceedingly important section. When we consider that from this group of bodies, many of which but a few years ago were quite unknown and others simply regarded as chemical and mineral curiosities, have come the incandescent mantle, the metal filament lamp, the pyrophoric alloys, the new steel alloys that are playing such a prominent part in ordnance, naval construction, and engineering, the production of X-rays as in the Coolidge tube, and a host of other minor applications, it must become evident to the most casual observer that the study of these substances gives promise of very substantial reward.

It does not seem too much to suggest that the application of the rarer elements may, in the near future, rival in value the coal-tar and other industries that are at the moment occupying so much attention.

A very interesting diagram is given showing at a glance the chief associates of the rare elements in natural and commercial products, but for some reason that is not clear the radio-elements have been left out of this scheme.

We congratulate the author upon the original form of index that has appeared in the last two editions—a device of very great convenience. Against each element is noted the page where the discovery, extraction, compounds, separation, experimental work, spectrum, and technical application are to be found: this enables one to put one's finger in a moment upon any subject needed and is of the greatest convenience.

J. H. GARDINER.

THE STUDY OF LIFE.

The Study of Animal Life. By Prof. J. A. Thomson. Revised edition. Pp. xvi+477. (London: John Murray, 1917.) Price 6s. net.

"FOR about a quarter of a century this book . . . has had an apparently useful life as an introduction to zoological science." With these words Prof. J. Arthur Thomson begins his short preface, and he is well and handsomely entitled to them. The book is not a large one, but it abounds in information, and the author sets it all forth in an easy way, with the practised skill of an old hand at teaching. The first part contains a few eloquent chapters on such themes as the "Wealth of Life," the "Web of Life," and the "Social and Domestic Life of Animals," and closes with a slighter sketch of the physiological functions and activities of the body; the second part, which is copiously illustrated, deals with structure and classification; the third, in like manner, with embryology; and the fourth and last with the facts and theories of evolution.

The array of facts is remarkable, and not less so is the immense number of recent or current theories which are dealt with or touched on in the book. Lamarck and von Baer, Spencer and Haeckel, Galton, Mendel and De Vries, and a hundred more, all find their place in a brief historic survey; they are all duly honoured, and occasionally criticised—but the book is not written for the sceptic. In writing a chapter on "Vitality" (as Prof. Thomson does not shrink from doing) he calls in a little host of thinkers and philosophers to help him—Huxley and Haeckel, Clifford and Joly, Child and E. S. Russell and Driesch; he leans in the end to views which he himself has done much to promulgate: "that we require ultra-material, notably *historical,* concepts for describing organisms. For the organism is a psycho-physical individuality (a mind-body or body-mind) which has enregistered within itself the gains of experience and experiment and has ever its conative bow bent towards the future."

In all popular books, however good they be, even as this one is, there is an inevitable tendency to make use, without more ado, of old familiar elementary statements, which are by no means always sound; just as the classical scholar, for instance, is (or used to be) too apt to take his texts for gospel, and to shirk the weary work of searching manuscripts. There is at least one such case, I think, where Prof. Thomson falls into error—in regard to the very common and familiar subject of the retraction or "sheathing" of a cat's claws; at the same time, if he offends, he does so in good company. His drawing (on p. 35) is a familiar one, closely resembling Mivart's, but it is not accurate; the figure "III.," for the third phalanx, points to the head of the second. But, and this is the important thing, Prof. Thomson explains the mechanism by saying that "the claw is retracted into its sheath—an adaptation for keeping it sharp when the animal is at rest or is simply walking." In like manner, Huxley talks of the claws being "completely retracted within the sheaths of the integument, when the animal does not desire to use them"; and Max Weber speaks of "die in der Haut zurückziehbaren Krallen, wodurch sie scharf bleiben." But the fact is that the "sheath" is very unimportant, if not wholly superfluous, part of the mechanism. Owen and Mivart do not mention it at all. It is a mere ruckle of skin, which neither covers nor protects the sharp point of the claw. John Hunter describes it with perfect accuracy: "The skin which covers the last phalanx is very loose; and when this phalanx is drawn up or back, the skin covers a great deal *of the root of the claw.*" But the really important fact is (as John Hunter was, I think, the first to show) that the last phalanx, claw and all, is crooked up or back, in a state of over-extension; so that the claw *is raised off the ground*—almost precisely as the hammer in a pianoforte is raised off the string.

D. W. T.

OUR BOOKSHELF.

The Cancer Problem: A Statistical Study. New edition. By C. E. Green. Pp. ix+140. (Edinburgh and London: W. Green and Son, Ltd., 1917.)

IT is well known that the incidence of cancerous diseases varies considerably in different districts and in different occupations. In this book Mr. Green has attempted to find some factor which will explain this difference in incidence, and he has critically examined the local distribution of cancer in different districts, particularly in Scotland, and the conditions which obtain in those districts. He finds that cancerous districts, as a rule, are particularly associated with the burning of coal as fuel, while in the non-cancerous ones wood or peat is the staple fuel. Thus in Nairnshire, which has the highest mortality figure from cancer in Scotland, the cancer deaths for the last ten years are confined to a definite area, while the rest of the county (100 square miles) is entirely free, and in the cancerous area coal is entirely or partially used as fuel, while in the non-cancerous area peat is universally used. The same holds good for other parts of the country. Thus, in the Orkneys, which, as a whole, have a cancer mortality slightly above that for Scotland, Stenness has a cancer death-rate of 1 out of 42 from all causes and peat is the only fuel, while in Sanday, where coal alone is burned, the cancer death-rate is 1 out of 9 from all causes. A strange anomaly, however, was met with. In Birsay and in St. Andrews, in the Orkneys, the cancer mortality is practically as great as in Sanday, yet peat only is burned. Investigation showed that the peat used in these two districts is peculiar, being hard and stony and having a high content of sulphur like coal. From these and other facts the author concludes that a high sulphur content of the fuel is

the factor correlating it with cancer. It must be admitted that the array of facts and figures produced by Mr. Green entirely favours his main proposition, and it is difficult to arrive at any other conclusion.

With considerable ingenuity Mr. Green applies his hypothesis to explain the incidence of cancer in certain occupations and in certain localities, and attempts to formulate an explanaton as to how sulphur compounds may give rise to cancer. Here he is on much less sure ground, and this part of the subject may well be left for the present. The book is illustrated with maps and diagrams, and is very readable and interesting.

R. T. HEWLETT.

A German-English Dictionary for Chemists. By Dr. A. M. Patterson. Pp. xvi+316. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 9*s.* 6*d.* net.

DR. PATTERSON has filled what has long been an irritating lacuna in the average chemist's library. Certain scientific and technical terms are by no means easy to translate from the German, and recourse to the dictionary usually available is generally hopeless. The book under review should therefore be eagerly welcomed by the steadily increasing number of young chemists in England and America and by those who, even if they have already a good working knowledge of the language, are occasionally at fault. Not only is it a good general dictionary of the German language, but it contains also a very complete collection of chemical terms belonging both to the pure science and to technology.

The book is prefaced by a useful introduction explaining, for example, the new official German spelling, and giving a short but valuable account of the special points of German chemical nomenclature and how they should be rendered into English according to the rules of the London and American Chemical Societies. It does not seem at all unnecessary, also, that the author should point out the danger of confusing chemical endings and case-endings; thus the student is often apt to translate "ketone" by "ketone" instead of "ketones."

Past participles, preterites, and present third singulars of simple verbs are a very convenient inclusion.

The book is clearly printed, the German being in roman type.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, February–July, 1917. Edited by R. M. Milne. Pp. 32. (London: Macmillan and Co., Ltd., 1917.) Price 1*s.* 3*d.* net.

MATHEMATICAL masters who prepare Army candidates for their entrance examinations will be glad to be able to procure this year's questions in this handy form, before they are incorporated later in Mr. Milne's large volume of examination papers.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Transparency of the Atmosphere for Ultra-violet Radiation.

IT is well known that the solar spectrum, even when observed from a mountain-top, so that there are fewer than four miles of "homogeneous atmosphere" overhead, does not extend so far as $\lambda 2900$, however long an exposure is given. It has further been long suspected that absorption by ozone is the cause, as originally suggested by Hartley. Perhaps it may be claimed that the recent work of Prof. A. Fowler and myself (Proc. Roy. Soc., A, vol. xciii., p. 577, 1917) leaves little or no room for doubt that this is the true explanation.

As a sequel to the work just mentioned, I have photographed the spectrum of a mercury-vapour lamp four miles distant, and found that it extends as far as the line $\lambda 2536$, and perhaps farther. This line lies near the maximum intensity of the ozone absorption band, and therefore ozone can have nothing to do with the limit of the spectrum in this case. To reconcile the two results, it is necessary to assume that there is much less ozone near the earth's surface than at high levels, a conclusion in agreement with the published chemical determinations of atmospheric ozone by Hayhurst and Pring.

The distant mercury lamp spectrum showed a considerable falling off of intensity in the region of short wave-lengths, long exposures being required to bring out $\lambda 2536$, which is one of the brightest lines when atmospheric absorption does not intervene. Such a result is to be expected according to known data on atmospheric scattering of light, apart from the action of ozone.

In this connection I may mention that I have succeeded in observing the scattering of light by pure dust-free air in a laboratory experiment with artificial illumination. Details of these investigations will be published later.

R. J. STRUTT.

Imperial College of Science, October 22.

The Cure of the Isle of Wight Disease in the Honey Bee.

THE publication of Mr. S. H. Smith's advertisement on p. 324 of the *British Bee Journal* for October 11, in which he mentions "proflavine" and "acriflavine" as being efficacious in the treatment of Isle of Wight disease, impels me to publish the following account, which I originally intended to keep back until further experiments had confirmed and extended the results.

On April 14 last I attended the annual meeting of the Leicestershire Beekeepers' Association, to offer my services in a full investigation of the Isle of Wight disease, which I proposed should be undertaken with the co-operation of the members. The meeting showed the greatest appreciation of my offer, and those present undertook to supply me with all the information and help they could.

Efforts were first directed to securing specimens of diseased bees for investigation, but, owing to the fact that I was unable to hear of any members who then possessed affected stocks, I did not come into contact with an actual case until July, 1917. In the meantime I had been discussing the general properties of the disinfectant flavine, which has been successfully used

in the treatment of wounds in the British Army, with Col. C. J. Bond, C.M.G., of Leicester, and it occurred to both of us that, if an opportunity could be found, it would be well worth while to experiment with acriflavine in connection with the Isle of Wight disease.

On July 6 I obtained an apparently healthy swarm of bees, which was at once successfully hived at the Leicester Museum. On July 11 numbers of the bees were seen crawling on the grass in front of the hive, and a batch had congregated on one of the legs. Previous to this the bees had been noticed to be slow in taking wing from the alighting board and to have a distended look. On July 16 I had a visit from Mr. S. Jordan, of 25 Longfield Road, Bristol, a well-known bee expert of many years' standing. We went to the hive and carefully examined the stock, and Mr. Jordan expressed his conviction that the bees were suffering from Isle of Wight disease, pointing to the "crawlers," the brown excrement which he squeezed from their distended bodies, and the dislocated wings of many as symptoms confirmatory of an opinion based on a lifetime's experience. Having already obtained some acriflavine, through Col. C. J. Bond, from Dr. C. H. Browning, director of the Bland-Sutton Institute of Pathology, Middlesex Hospital, W., I at once placed a feeder on the top of the brood box, containing a pound of honey to which had been added forty cubic centimetres of a solution of acriflavine (strength 1 in 1000, *i.e.* one gram of acriflavine to a thousand cubic centimetres of water). In addition to this, I sprayed the bees, over the top of the frames, with a quantity of the acriflavine solution (1 in 1000) until most of the bees were distinctly wet. The next day the bees appeared much livelier and more alert than at any time since their arrival, but during the subsequent week crawlers appeared from time to time. They were, however, much more active than those previously seen, and were generally engaged in vigorously working their abdomens and rubbing their sides with their hind-legs. I was glad to notice that the bees were taking the acriflavine-honey down quite freely from the feeder, which I continually replenished, and gradually the crawling symptoms disappeared.

On opening the hive in the latter part of August I found the colony much reduced in numbers, but looking beautifully clean and healthy, with a quantity of acriflavine-honey stored in the brood frames. This was very obvious, owing to the greenish fluorescent tinge which acriflavine imparts to mixtures. There were no signs of crawling, but the small size of the colony led me to think that most of the crawlers had probably not been cured but had died off, the inference being that the acriflavine had prevented the infection from spreading to the young bees which had taken their place. I am inclined to think that if I had mixed a little honey with the spraying solution of acriflavine I should have possibly saved the diseased members of the hive, because they would have taken in the solution much more readily. This is a point calling for further trial.

During the course of my experiments I tried feeding the bees with a syrup made from cane-sugar, to which acriflavine solution (1 in 1000) had been added, at the rate of twenty cubic centimetres of solution to each pound of syrup. The bees, however, refused to take this mixture, and I had to return to honey. Latterly, since the advent of colder weather, the bees have refused to take down even honey when acriflavine was mixed with it to the above strength, and I am forced to conclude that it is only during that part of the year when they are fairly active that they will take the acriflavine from a feeder. This is confirmed by Mr. J. Waterfield, of Kibworth, to whom I gave a supply of acriflavine solution for the purpose of experiments upon his own bees. They, like mine, refused to take down the solution, although supplied in honey.

I have given out several supplies of acriflavine solution to beekeepers whose stocks have been attacked by the disease, within the last three or four weeks, but owing to the lateness of the season there have been no visible effects to report, and although I consider my own results distinctly encouraging, I should not have ventured to mention acriflavine at this stage but for Mr. Smith's advertisement. It now seems important to have all possible information regarding it, and I hope Mr. Smith will publish his experiences, which would appear to be more extensive than mine.

Turning to the question of the cause of the Isle of Wight disease, I have been quite unable to detect any trace of the Protozoan parasite *Nosema apis* in any of the diseased bees which I have examined. I have submitted dozens from the infected hive at the museum to a very careful microscopic examination, and have also examined specimens from three other localities in Leicestershire, all of them "crawlers" from hives showing all the ordinary symptoms of Isle of Wight disease, without finding *N. apis* in a single case. I am, therefore, at present in complete agreement with Messrs. Anderson and Rennie, who state, in an important paper in the Proceedings of the Royal Physical Society of Edinburgh, 1915–16, vol. xx., part 1, pp. 16–61, that, after extensive observations and experiments, they are "unable to recognise any causal relation between the presence of this parasite and the disease."

In all the specimens I have examined, bacteria were abundant in the contents of the rectum, and it is difficult to resist the impression that the trouble may be due directly or indirectly to these organisms, although the statement is made by Dr. Malden, in the Board of Agriculture's second report on the Isle of Wight disease, in July, 1913, that "investigations have failed to reveal any species of bacteria constantly associated with the symptoms of the Isle of Wight disease."

As a beginner in beekeeping and a new worker in the field, I am impressed by the need for much further investigation as to the cause and cure of this troublesome disease. I hope, however, that in view of the good results which have been claimed for bacterol, and the possibilities presented by acriflavine, beekeepers may take courage and face whatever risk may be involved in beekeeping, as a national duty in these days of sugar shortage.

It should be mentioned that my work is being carried out under the auspices of the Museum and Libraries Committee of the Leicester Corporation, which has provided me with every facility. On its behalf I should be glad to supply, free of charge, sufficient acriflavine for a good trial to any beekeeper having the disease among his stocks who will apply to me at the Leicester Museum, and undertake to send me an account of the result.

E. E. LOWE.

The Museum, Leicester, October 16.

Tidal Energy Dissipation.

IN regard to my estimate of viscous dissipation of oceanic energy in its bearing on the slowing of the earth's rotation (Proc. Roy. Soc., A, 93, p. 348), I quite assent to Mr. Jeffreys's position (NATURE, vol. xcix., p. 405, July 19, 1917) that it is still open to doubt whether the viscosity of the ocean causes a very appreciable part of the earth's retardation. The formula for calculating the rate of dissipation of internal energy by viscosity, in the absence of disturbing forces, from a knowledge of the surface currents alone, is not challenged. But, irrespective of his argument, this

internal energy, especially that associated with the longer-period motions, will be in part energy of currents arising from temperature differences, and therefore supplied by the solar heat and not by the energy of the earth's rotation. The contribution from the shallower parts of the ocean may have more chance of falling under the latter head. In any case, the whole question can be discussed only when more is known as to the distribution of the oceanic currents. At present the only motion known at a considerable distance from land is the residual drift, and this only in a few places, chiefly where it exceeds one knot. But as this does not change with the tide, its energy is of thermal origin.

It is more difficult to agree with Mr. Jeffreys's contention that viscous action in a solid earth cannot be an appreciable cause of the slowing of its rotation. By using a special law of viscosity quoted by him (M.N. Roy. Astron. Soc., vol. lxxvii., p. 449) as suggested amongst other possibilities by Sir J. Larmor as a reasonable alternative to the Maxwell-Darwin law used by him previously (M.N. Roy. Astron. Soc., vol. lxxv., p. 648), he himself has considerably modified his previous views. But a wide field of choice is open, of which this is one example. Thus the law might be that the ratio of the stress to strain is $n+f(d/dt)$, where f is any function. In order to give the required values of the earth's retardation and of the Eulerian nutation, the function f is defined for only two values of the argument, and so is to a great extent arbitrary. Evidently suitable forms may be chosen in very many different ways, so as, in addition, to allow for the properties of earthquake waves.

R. O. Street.

University of Liverpool.

Stereo-Radioscopes.

We have read with interest in the Notes columns of Nature of October 18 a description of what is called a stereo-radioscope, said to be invented by one Major Lièvre. What interests us so much is the fact that Sir J. Mackenzie-Davidson invented the same thing no fewer than twelve years ago. The instrument was made by our firm and put on the market for several years. As the two sources of rays have to be about 6 cm. apart, the only practical method was found to be to build a special X-ray tube with two anti-cathodes in the same bulb.

The apparatus was exactly the thing described in your paragraph. A motor drove an interrupter having two contact blades opposite each other, exciting the two sides of the tube alternately and driving a stroboscopic shutter synchronously with the interrupter.

The great objection to the instrument is that the operator must look into the view-box in front of the shutter, thus fixing his position with regard to the large and heavy instrument. Either this latter or the patient must be adjusted to obtain the proper view.

The difficulty of this is obvious, and results in an expensive and cumbersome apparatus.

Harry W. Cox and Co., Ltd.

161 Great Portland Street, London, W.1.

An Optical Phenomenon.

Capt. C. J. P. Cave's letter in Nature of October 18 reminds me of a similar effect experienced when travelling in a *coupé* compartment at the rear of a train some years ago. From a window at the back of the *coupé* one could watch the ever-disappearing landscape as the train travelled along. The impression created was that every object seen appeared to be rushing away from the train. But a stranger sensation occurred when turning my eyes from the window to objects in the *coupé*, for, during a space of a few seconds, they appeared to be moving rapidly in a contrary direction.

C. Carus-Wilson.

October 19.

The effect described by Capt. Cave in Nature of October 18 can be observed after walking rapidly along the top of a wall and keeping the eyes fixed on the road. On stopping, still looking at the road, part of the field of view seems to be slipping away backwards.

H. M. Atkinson.

45 Denman Drive, N.W., October 19.

INFANT AND CHILD MORTALITY.

Political economists are generally agreed that, if a country is to be prosperous and to maintain its place among the nations, its population must substantially and progressively increase. Two cardinal factors are essential to ensure a satisfactory increase of population: (1) a birth-rate maintained at a proper level, and (2) a death-rate not excessive. A falling birth-rate and an excessive mortality are both national calamities; indeed, it may be questioned if France would be quite in her present position had her birth-rate equalled that of Germany. In France the birth-rate, already abnormally low, fell from 23·5 per 1000 in 1887 to 19·0 in 1914, while for Germany for the same years the figures were respectively 36·9 and 28·3, with the result that during this period the population of France only increased from about 38¼ millions to 40 millions, whereas that of Germany increased from 49 millions to 65 millions.

We are in a similar parlous state as regards our birth-rate, for this has been steadily declining from 36·3 in 1876 to 23·0 or thereabouts in 1916 per 1000 of population. The effect of this has been that our increase of population for 1914 was *less* by nearly half a million than it would have been had the birth-rate obtaining in 1876 been maintained. Fortunately, our mortality-rate is one of the lowest in the world, and this, together with a considerable saving of infant and child lives, has enabled us to show a substantial increase of population. We are, nevertheless, still faced with a low and apparently falling birth-rate (for the County of London the birth-rate was 21·5 for 1916, against 22·5 for 1915), and we must, moreover, take into account the serious losses among the adult male population, the potential and prospective fathers of children, owing to the present war. It does not, therefore, appear that any substantial increase in the birth-rate can at present be anticipated.

We are, then, more than ever dependent upon a diminution of mortality if our increase of population is to be maintained. But with a death-rate among the whole civil population of 14·7 per 1000 (1916), we can scarcely expect any considerable diminution in the general mortality. Is there any section of the community among whom the mortality is excessive and might be reduced? An analysis

of the mortality statistics brings out some startling facts. Of the total deaths occurring in England and Wales during the four years 1911–14, 28·2 per cent., or *more than one-quarter,* occurred during the first five years after birth; the number of deaths of persons sixty-five to seventy years of age is less than of children one to five years of age, and it is not until the age of seventy years and upwards is reached that the mortality is greater than that of infants up to one year of age. For England and Wales the present infant mortality (*i.e.* deaths of infants up to one year of age) per 1000 births is about 110. This means that of the 800,000 infants born in a year some 100,000 never live to see their first birthday. Further, probably at least as many prospective children die before birth, and half the number between one and five years of age, so that out of 900,000 possible children 250,000 have succumbed by the end of the fifth year. What should we think of 250,000 casualties—all fatal—out of 900,000 in action? And what of the uncounted wounded and disabled?

It may be said that, high as our present infant mortality appears from such figures, it is, at any rate, much less than formerly. Fortunately for the nation, this is quite true; the infant mortality has fallen from 165 in 1899 to 110 at the present time. But, even so, there is still an appalling mortality among infants and young children, and the pity of it is that it is undoubtedly largely preventable. The best proof of this statement is, perhaps, the startling difference in child mortality in different districts. We find, for example, that during the first year of life:

In Burnley	172	die against	67 in Hornsey
In Stoke-on-Trent	161	„ „	70 in Ilford
In Wigan	159	„ „	78 in Bath

If, instead of taking the death-rate of infants, we take that of children up to five, the result is the same:

In Middlesbrough	251	die against	109 in Bournemouth
In St. Helens	242	„ „	110 in Ealing
In Oldham	223	„ „	127 in Croydon

But this is not all. So far these towns have been considered as a whole, but the worse have their good and bad parts. Thus, while the general child mortality up to five in Middlesbrough is 251 per 1000 births, for the Canon Ward it is 328, and for the St. Hilda's Ward 369! If we survey the country generally, it will be found that child mortality is greatest in the large industrial towns and mining centres, less in the smaller towns, and least in the rural districts. Poverty is not the dominant factor, for the highest child mortality occurs in areas where, on the whole, wages are good, and Dr. Findlay, in a report to the Medical Research Committee, notes that in times of famine and industrial trouble the infantile death-rate usually falls. He emphasises the importance of environment (housing, etc.) as a factor in causing the present high infantile mortality.

Of the total deaths of children up to five years of age 12·3 per cent. are due to measles and whooping cough, 19·5 per cent. to bronchitis and pneumonia, 15·8 per cent. to diarrhœal diseases, and 23·0 per cent. to "congenital debility." It is fairly obvious that diarrhœal diseases and congenital debility are largely dependent upon the conditions under which the people live, and the same holds good also for the other diseases mentioned. We find, for example, that, as regards measles and whooping cough—two diseases over which we have the least control—6 per 1000 die of these diseases in Harrogate and Weymouth, against 41 in Sheffield and Stalybridge. With facts of this kind before us it is patent that a considerable saving of child-life might, and ought to, be accomplished. Of the factors conducing to child mortality, the principal are ignorance and carelessness, intemperance, disease, and poverty, overcrowding, vitiated atmosphere, impure milk supply, and defective sanitation.

The remedies are, for the most part, obvious; they comprise: (1) A better training for motherhood on the part of girls of all classes; (2) improved care of the prospective mother and the provision of well-trained midwives, health visitors, and maternity and child-welfare centres; (3) the clearing out of slum areas; (4) improved housing of the masses, with a wider distribution of the population and better sanitation; and (5) an equitable solution of the drink problem. A great deal can be done by certain measures of care and supervision alone. Mr. Benjamin Broadbent, when Mayor of Huddersfield in 1905, tried such an experiment, with the result that of 112 babies born in that year, 107 survived the first year, and ninety-seven were surviving in 1915, ten years later, whereas, according to the average rate of mortality, only eighty-four would have been alive in 1915!

It ought to be appreciated by every right-thinking man and woman that the child is a national asset of great price, and that the saving of child-life is a duty, national as well as humanitarian. The problem is a vast and complicated one and worthy of the best efforts of the State, yet how little has hitherto been done to grapple with it on anything like a national scale. Mr. Hayes Fisher has recently promised to introduce, and if possible to pass by Christmas, a Maternity and Infant Welfare Bill to deal with the problem. He indicated, however, that delay might be caused by sources of opposition much the same as have apparently obstructed the formation of a Ministry of Health. Let us see to it that Mr. Hayes Fisher's hands are strengthened by the force of public opinion. The call is urgent, and human lives, so much needed by our country, are at stake.[1]

R. T. H.

[1] For data bearing on this subject, see "Report on Maternal Mortality in connection with Child-bearing and its Relation to Infant Mortality"; "Report on Child Mortality at Ages 0–5 in England and Wales" (L.G.B. Reports, Cd. [illegible]5 and 8496); "The Problem of Infant and Child Mortality," by J. Sheldon Withers, Medical Officer of Health for Sidmouth; "The Mortalities of Birth, Infancy, and Childhood," by Drs. Brend, Findlay, and Brownlee (Special Report Series, No. 10, Medical Research Committee).

THE STUDY OF A GENUS OF LAND SNAILS.[1]

THE Rev. J. F. Gulick, in an important paper published by the Linnean Society in 1873, described the distribution of the land snails belonging to the family Achatinellinæ that are found in the Hawaiian islands, and pointed out that neighbouring valleys in these islands, although presenting the same environmental conditions, are inhabited by distinct species. He regarded this as an example of a diversity of evolution under one set of external conditions which was rendered possible by isolation in the different valleys.

Darwin had stated in "The Origin of Species" that isolation is an important element in the modification of species through natural selection. But if the environmental conditions in the localities inhabited by distinct species are in all essential respects the same, natural selection takes no part in the evolution of species, and we must assume some inherent tendency to evolution, some *vis a tergo* which works along definite lines of divergence independently of external conditions. The question is one of very great importance, and further investigations both on the variations of the shells and on the conditions of their environment were greatly needed. In the magnificent memoir before us Prof. Crampton supplies the materials for reopening the discussion.

Partula, belonging to the family Bulimulidæ, is one of the genera of snails, confined to certain islands in the South Pacific Ocean, which show a distribution of distinct species in adjacent valleys similar to that of the Achatinellinæ in Hawaii.

The author has collected and examined an enormous number of shells, has personally studied the habits of the snails in their localities, and has put together his copious notes on the vegetation, meteorology, and topography of the islands. The present volume deals only with the species of Tahiti, but we are promised further volumes on the species of the genus from other localities.

As a detailed study of a single genus, however, this volume is the most complete of anything of the kind that has yet been attempted, and we may congratulate the author on the conclusion of this the first stage of his most laborious task.

To illustrate his study of the local conditions, we are provided with a large number of maps and sketches of a topographical model of the island, with many excellent photographs of the vegetation, and with tables of temperature and rainfall; and to illustrate the species he describes there are fifteen excellent coloured plates. For each of the species and varieties of the species in the island the author gives us the mean value of the measurements of the shells and of the apertures of the shells, together with the standard deviation, and in many cases the results are plotted out in frequency polygons.

Limitations of space do not permit further reference to the details given in this very laborious piece of work—a work which will prove essential to those who are interested in the problem of the differentiation of species.

It may be disappointing that the author does not state more decisively what his conclusions are from this elaborate study, but, although the material is already so extensive, it is perhaps wise, on his part, to delay his statement of conclusions until the series of memoirs is completed. It is clear, however, that the author is convinced that differences of environmental conditions cannot be held responsible for the differentiation of the species and varieties. In dealing with the widely spread species, *Partula otaheitana,* for example, he says that "the *rôle* of the environment is to set the limits to the habitable areas, or to bring about the elimination of individuals whose qualities are otherwise determined—that is, by *congenital factors*"; but, of course, there is no suggestion as to the cause of the change or diversity of the congenital factors.

The facts that are given in various chapters which seem to have a bearing on Mendelian inheritance are, as the author admits, not very satisfactory. Breeding experiments on an extensive scale can alone determine whether there is in Partula a Mendelian segregation similar to that described by Lang in Helix. The evidence of the occurrence of mutations, also, other than the dextral-sinistral mutation, which does not, as a rule, help to differentiate species, is not by any means conclusive.

It seems quite possible that, with the wealth of species, sub-species, and varieties which this memoir reveals and illustrates, the conclusion may be drawn that, after all, the genus Partula may afford an example of the evolution of species by the accumulation of small variations, although the cause of this accumulation still remains a mystery.

S. J. H.

[1] "Studies on the Variation, Distribution, and Evolution of the Genus Partula." By Prof. H. E. Crampton. Pp. 342+34 plates. (Carnegie Institution of Washington, 1916.) Price 15 dollars.

CONTINUATIVE EDUCATION AND ITS OBJECTS.

A COMMITTEE of Scottish teachers, chosen from all branches of school education, has recently issued a report entitled "Reform in Scottish Education,"[1] which covers a wide field and embraces a large variety of topics. Many of the reforms advocated have already been set forth by others, and, in particular, by the Workers' Educational Association. In common with the latter body, the Scottish committee recommends the raising of the leaving-school age of the primary school to fifteen years; the reduction of the size of classes, so that every teacher shall have not more than forty pupils under his charge at any one time; and the establishment of day continuation schools, to which all shall be compelled to go from fifteen to eighteen, unless they are already in attendance upon a course of secondary instruction. The committee also demands the abolition of the

[1] Report of the Scottish Education Reform Committee. (34 North Bridge, Edinburgh.) Price 1s. net.

huge "factory" school, found so often in our large towns, and would limit the enrolment so that no school should accommodate more than 600 pupils.

These reforms, it is declared, would tend not only to the efficiency of education, but also to the betterment of the teacher's position as regards both emoluments and social status. But the fallacy underlying a large number of the propositions laid down in a more or less arbitrary manner (for there is little or no attempt made to adduce reasons for the changes advocated) is that education may be improved by a mere extension of time. Education is at present compulsory in Scotland until fourteen years of age, and even then a considerable percentage of the children in attendance fail to attain any satisfactory standard in the "three R's." Extend this by one year, and all will be well. It seems never to have occurred to the committee that a change in the methods of elementary education might bring about better results than the present, even at the earlier age. The object of education is to supply the child with ideas which shall be instrumental in after life, and these instruments can be intelligently and efficiently used just in so far as the child understands not only the instrument, but also the principles upon which it has been constructed.

Now, few teachers realise the instrumental character of ideas, or that the activity of knowing arises either to satisfy a need or to meet a new situation, and that the failure of education is due largely to the neglect of these considerations. To take an example: If the continuation school, on the technical side, is to achieve its object, it must provide opportunities for the meeting and solving of the real situations and problems of the workshop. If this is borne in mind, then it must be obvious that continuation schools can be instrumental in solving only a limited number of the real problems which arise in life, and that in many cases a boy or girl will obtain the best technical education in learning how to meet the situations which arise from real work. The boy, *e.g.*, whose desire is to become a fisherman will obtain the best training by his daily work, and will benefit little by being compelled to attend a continuation school until eighteen years of age. Rather, he will probably waste his time, and so render himself less fit for his daily avocation; and if we go on, we shall come to other exceptions, and find that, like all general rules, the particular principle that all boys and girls should be compelled to attend some kind of school until eighteen is too wide to be of any practical value in solving the real problems of life and of education.

A somewhat similar fallacy arises from the demand made for more science teaching in schools. Because science deals with realities in contrast to the humanities which are said to deal only with ideas, therefore education in science will be real because it deals with realities. But real problems, real situations, are often absent in the teaching of science in schools. A boy learning chemistry may throughout deal with realities, and yet never be called upon during his course to solve a real problem, since for him the need never arises. Generally we must ever keep in mind that education is taking place only when our pupil is "thinking"; that thinking arises only when there is some problem to solve, some new situation to meet, or some obstacle to remove; and that when these conditions are absent all instruction becomes, and must become, mere unintelligent memorising, which develops neither the intellectual powers nor the ability to meet the after demands of life.

In conclusion, the one reform needed at present is to form a clear idea of what education really is—to understand that it takes place only when our pupils are being trained to think out solutions to real problems, or to devise means to meet real situations. Thereafter we may fruitfully discuss the agencies best fitted to attain this end, and, as a consequence, we may be less chary of believing that a new earth is to be attained by the extension of the leaving-school age and by the compulsory school education of all until eighteen. We may even doubt whether "compulsory" education is education at all.

A. D.

NOTES.

THE death is announced, at seventy-three years of age, of Prof. A. J. F. Dastre, director of the laboratory of animal physiology at the Sorbonne, and a member of the Paris Academy of Sciences.

WE regret to see the announcement of the death on October 18, in his eighty-ninth year, of Prof. Edward Hull, F.R.S., late Director of the Geological Survey of Ireland, and professor of geology in the Royal College of Science, Dublin.

MR. W. B. WORTHINGTON, who was elected president of the Institution of Civil Engineers at the last annual general meeting, has resigned the position from reasons of health, and Mr. H. E. Jones, a vice-president, has been nominated president for the year 1917–18.

AT a meeting of the Royal College of Physicians of London, held on Thursday, October 18, the Baly medal, for physiological work, was presented to Prof. W. M. Bayliss, and the Bisset-Hawkins medal was given to Sir Arthur Newsholme, in recognition of his efforts for the advancement of sanitary science.

THE death is announced of Sir John Prichard-Jones, Bart., principal of the firm of Messrs. Dickins and Jones, the London drapers. He took an active interest in higher education in Wales; he was treasurer of the Welsh National Museum, and a member of the council of the North Wales University College, Bangor, of which he was senior vice-president from 1909 to 1913. The University of Wales conferred upon him the degree of LL.D.

ON the occasion of the recent Glasgow meeting of the Refractory Materials Section of the Ceramic Society, the council appointed two sub-committees (with power to co-opt additional members) to prepare reports respectively on (1) standardisation of methods of testing, (2) refractories for spelter furnaces. It is anticipated that the former will be ready for the spring meeting in Sheffield, and the latter for the following autumn meeting at Cardiff.

WE learn from the *Times* that Mr. Walter Long has appointed Sir Boverton Redwood, Bart., Director of Technical Investigations in the recently created

Petroleum Executive, with the view of his dealing with technical questions of the highest importance, including the co-ordination of the work of petroleum production and that of petroleum research. In order to devote himself to his new duties Sir Boverton Redwood will cease to act as Director of Petroleum Research.

IN answer to a question asked in the House of Commons on October 18 the Chancellor of the Exchequer said:—"The proposal of a Ministry of Health is under careful consideration; at present the various difficulties needing to be provided for in the establishment of such a Ministry have not reached any widely agreed solution, and so long as this is so it is not possible to undertake to introduce a Bill for the purpose. Steps are, however, being taken which will, it is hoped, secure substantial agreement amongst those who are actively engaged in the work of national health."

THE *Times* of October 24 announces the death of Surgeon-General Sir Charles Pardey Lukis, K.C.S.I., Director-General of Indian Medical Services, at sixty years of age. Sir Charles received his professional education at St. Bartholomew's Hospital, and entered the Indian Medical Service in 1880. In 1905 he was appointed principal and professor of medicine in the Calcutta Medical College, and was selected to be Director-General at the beginning of 1910. He took especial interest in original research in medicine in India, and edited a journal devoted to this subject, as well as two or three well-known tropical medical text-books; he was also the author of "A Manual of Tropical Hygiene."

AT the annual statutory meeting of the Royal Society of Edinburgh, held on October 22, the following office-bearers and members of council were elected:—*President*, Dr. J. Horne; *Vice-Presidents*, the Right Hon. Sir J. H. A. Macdonald, Prof. R. A. Sampson, Prof. D'Arcy Thompson, Prof. J. Walker, Prof. G. A. Gibson, and Dr. R. Kidston; *General Secretary*, Dr. C. G. Knott; *Secretaries to Ordinary Meetings*, Prof. A. Robinson and Prof. E. T. Whittaker; *Treasurer*, Mr. J. Currie; *Curator of Library and Museum*, Dr. A. C. Mitchell; *Councillors*, Dr. J. H. Ashworth, Prof. C. G. Barkla, Prof. C. R. Marshall, Dr. J. S. Black, Sir G. A. Berry, Dr. J. S. Flett, Prof. M. Maclean, Prof. D. Waterston, Prof. F. O. Bower, Prof. P. T. Herring, Prof. T. J. Jehu, and Dr. A. Lauder.

THE series of meetings arranged by the director of the Meteorological Office since 1905 for the informal discussion of important contributions to meteorological literature, particularly those by Colonial or foreign meteorologists, was reopened on Monday, October 22, at 5 o'clock, and will be continued until March next. Among the subjects to be considered are:—The distribution of cyclonic rainfall in Japan; the Aurora Borealis expedition of 1913 to Bossekop, Norway; the height of the Aurora Borealis; monthly mean temperatures of the surface water in the Atlantic north of lat. 50° N.; (1) types of storms in the United States and their average movements, (2) types of anticyclones; the properties of revolving fluid; meteorology of Norway; and aerography.

DR. ROBERT BRAITHWAITE, whose death on October 20, in his ninety-fourth year, is announced, was a fellow of the Linnean and Royal Microscopical Societies, as well as of several foreign natural history societies. He entered the medical profession in 1858, and became M.D. of St. Andrews in 1865. His three elaborate volumes on "The British Moss-Flora," of which the publication was completed in 1905, constitute the standard work upon their subject. All the 128 pages of plates which illustrate this work were engraved from drawings made by the author himself, and the whole work forms a remarkable monument of his skill and industry. The Sphagnaceæ were not included in the volumes, but Dr. Braithwaite published an interesting monograph upon these, namely, "The Sphagnaceæ, or Peat Mosses of Europe and North America."

THE Minister of Munitions has issued an order that no person shall deal in potassium compounds except under a licence issued by the Controller of Potash Production. No licence will be required (*a*) by the Admiralty or War Office; or (*b*) by any person for the purchase of potassium compounds in quantities not exceeding 3 lb. in any one calendar month. All persons must furnish returns to the Controller of Potash Production of all potassium compounds under their control, manufactured, or dealt in by them. The potassium compounds to which the order relates are the hydrate, chloride, carbonate, and sulphate, whether in a pure or in a commercial form, and any material (other than blast-furnace dust referred to in the order of the Minister of Munitions of August 7, 1917) of which more than 10 per cent. consists of any one or more of the above.

A MEETING is to be held at the Manchester School of Technology in the afternoon of Saturday, November 10, under the chairmanship of Dr. Alfred Rée, for the purpose of inaugurating a British Association of Chemists. The objects of the proposed association are "(*a*) to obtain power to act as sole registration authority for all chemists; (*b*) to have the word chemist legally redefined; (*c*) to safeguard the public by obtaining legislation ensuring that certain prescribed chemical operations be under the direct control of a chemist; and (*d*) to raise the profession of the chemist to its proper position among the other learned professions, so that it may attract the attention of a larger proportion of the best intellects, and thereby secure a supply of highly trained chemists adequate to the industrial needs of the country." The meeting is open to all chemists. The hon. secretary of the Provisional Committee is Mr. R. E. Crowther, 3 Langford Road, Heaton Chapel, near Stockport.

A PRIVATE letter from Dr. Paul Bertrand announces the death of his father, Prof. C. E. Bertrand, the distinguished plant-anatomist and palæobotanist. Among recent plants Prof. Bertrand elucidated the structure of Gnetaceæ and Conifereæ (1874), of Tmesipteris (1881), and of Phylloglossum (1882), and in 1902 published, in conjunction with Prof. Cornaille, a remarkable theory of the construction of the vascular strands of the ferns and other plants. In fossil botany he investigated the problematical fossil Algæ of the Boghead Coal (1892–94), worked out the detailed structure of the famous *Lepidodendron Harcourtii* (1891), discovered the minute Carboniferous Lycopod, Miadesmia (1891), and described one of the first examples of a ribbed Sigillaria, with structure preserved. Perhaps his most important palæobotanical work was his researches, in collaboration with Renault, on the Poroxylons, a most elaborate study of a remarkable group. His latest papers were on the comparative structure of various Palæozoic seeds (1907–11). He also wrote on the formation of coal and on the Iguanodon coprolites of Bernissart. His work was characterised by the most careful accuracy and an almost mathematical precision. Bertrand was professor of botany at Lille, and lived there for the last three years of his life under German rule. Under these difficult and painful conditions, he was still able to carry on both his university courses and his private research, as long as his health permitted. His death took place in August, but the sad news only reached his son this month.

Mr. W. Thomson, in his presidential address to the Manchester Literary and Philosophical Society on October 2, gave a sketch of the very important work which had been done by the society since its inauguration in 1781, as a continuation of the Warrington Academy, which was established twenty-four years earlier (1757), in which it is believed that Marat, the great French revolutionist, taught languages. Joseph Priestley, the discoverer of oxygen in 1774, was teacher of languages and *belles lettres* at that academy in 1761. Later, whilst at Warrington, he began the study of science, and was afterwards a member of the society. Both Dalton and Joule were closely connected with the society: the former had his laboratory in the present society's rooms. He was elected a member in 1794, and was president from 1817 until 1844. During the last 136 years most of the eminent scientific men of Manchester have been members of this society, and have contributed to its memoirs. Dr. Henry Wilde, with others, subscribed handsomely to the extension of the present premises in 1883, and then bequeathed to it an endowment of 8265*l.*, the interest of which is at present employed for the purposes of the society. The members of to-day include the most eminent men of science in Manchester, and there are at present about 150 members. Since the war commenced the value of scientific knowledge has been more highly appreciated in England than ever before, and it is to be hoped that manufacturers and others in Manchester will show their appreciation of science by joining the society.

We regret to announce the death on October 18 of Mr. George Charles Crick, assistant in the geological department of the British Museum. Mr. Crick was born at Bedford on October 9, 1856, and received his scientific education at the Royal School of Mines, of which he was an associate. He was appointed to the staff of the British Museum in 1886, and devoted himself to the care and special study of the fossil Cephalopod Mollusca. Though he had been in failing health for some years he continued to attend to his museum duties until the end, and on the day before his death he was able to discuss with Dr. Kitson the geological age of some new ammonites from Nigeria. His knowledge of the fossil Cephalopoda was, indeed, so profound that his services were in constant request by geologists investigating new countries, and his published writings, though numerous, give only an imperfect idea of the extent of his researches and their importance for the progress of stratigraphical geology. He was of too diffident a nature to do full justice to his powers. Most of his papers were naturally technical descriptions of genera and species, but among those of wider scope may be specially mentioned his memoir on the attachment of the fossil Cephalopoda to the shell, published by the Linnean Society, and his valuable report on the Cretaceous Cephalopoda of Natal. Mr. Crick was awarded the Barlow-Jameson fund by the Geological Society in 1900, and the general appreciation of his scientific worth was equalled by the esteem in which he was held by his colleagues and all who were associated with him.

The Herbert Spencer lecture was delivered at Oxford on October 20 by Prof. Emile Boutroux, member of the Institut and of the French Academy. The lecture, which was given in English, embodied a careful analysis of the relation between thought and action from the German and classical points of view. The contrast between the two conceptions was well brought out by the lecturer, whose treatment of the subject was, however, metaphysical rather than scientific. The modern German view was traced back to Kant, according to whom thought is conditioned in such a way that by the nature of things the present is entirely controlled by the past; hence the laws of thought are determined mechanically. The only true action is that where the effect is conditioned by the subject. From this follows the radically dualistic conception that thought and action move in two worlds which have nothing in common. But by Fichte and others it was recognised that action was only possible through the world of sense. Hegel applied to the content of action the law which Fichte had applied to its production. "The world of phenomena *creates* the world of freedom." Germany proceeded to preach that the ever-increasing control of *our* world was the only field of action. Thus action bears its own law in itself; all scientific explanation resolves itself into mechanism. Phenomena come within the sphere of action. If the Kantian conception with its implications be admitted, the attitude of modern Germany is justified. Contrast with this the truer view of antiquity, especially as brought out by Plato, viz. that thought and action are not mutually exclusive, but interdependent constituents of human life, neither being self-sufficient. With the Aristotelian τὸ καλὸν we get a living medium between action and thought; hence comes individuality and with it an indefinable enlargement of the inner life. We are free when we exercise self-control—

> Vis consili expers mole ruit suâ:
> Vim temperatam di quoque provehunt
> In maius.

Carcinologists are indebted to Dr. J. J. Tesch, who, in *Zoologische Mededeelingen* for July, gives a long synopsis of the marsh-crabs of the genus Sesarma and allied genera, illustrated by numerous plates and text-figures. The special feature of this contribution is the key which the author has devised for the identification of the Indo-Pacific species, a task which so far has not been attempted. He also gives a brief summary of what is known of the habits of these creatures.

Dr. E. C. Hort, in the Journal of the Royal Microscopical Society for August, gives a detailed account of his attempts to unravel the life-history of the meningococcus of cerebro-spinal fever, and if the statements of his results provoke criticism his investigations will have served a very useful purpose. Perhaps the most important of his results is his claim to have demonstrated the presence of excessively minute, filterable organisms which are quite as pathogenic as unfiltered cultures. In so far as prophylaxis is concerned he does not seem to have made any advance on the admirable work in this field by Lt.-Col. Gordon, summarised in these pages in April last.

In 1886 Dr. W. E. Hoyle named a Cephalopod, taken in the Pacific by the *Challenger* Expedition in 1874, *Moschites verrucosa,* believing it to be identical with the species of that name common in the Atlantic. Mr. S. Berry, in the Proceedings of the Academy of Natural Sciences of Philadelphia, vol. lxix., part 1, negatives this decision, showing conclusively that, though closely resembling this species, it nevertheless presents so many structural peculiarities that it is entitled to rank as a distinct species, which he proposes to call *Moschites challengeri*. Mr. Berry has not examined the original specimen in the British Museum of Natural History, but he contends that photographs of the specimen which have been sent him justify his contention. He bases his decision on the form of the "hectocotylus," the distribution of the tubercles of the umbrella, and the relative lengths of the arms. This issue of the Proceedings also contains a paper by Messrs. H. A. Pilsbury and A. Brown on Oligocene fossil Mollusca from the neighbourhood of Cartagena, Colombia, wherein they de-

scribe eighteen species and two subspecies new to science. Finally, Messrs. J. Henderson and L. E. Daniels contribute a long paper, likely to interest malacologists, on hunting Mollusca in Utah and Idaho, since they record some valuable ecological observations.

WE have received from the Royal Italian Oceanographic Committee a memoir (No. xxi., 1916) by the secretary, Prof. Giovanni Magrini, setting forth its objects and giving a short account of its activities. The committee was established in 1910 for carrying out physico-chemical and biological investigations in Italian seas and for the study of the higher atmosphere. There are influential provincial sub-committees at Genoa, Naples, and Venice, which undertake work of especial importance in their respective areas, *e.g.* the Venetian sub-committee has carried out experiments with the object of developing the fisheries off the Albanian coast. The committee has, in an excellent situation at Messina, a central Institute of Marine Biology, capable of accommodating eighteen workers, besides the staff, and a motor-boat provided with the usual apparatus for plankton and other work. In addition, the committee has a well-equipped steamer 124 ft. long, with accommodation for eight technical experts and two assistants. During the years 1909–14 fourteen cruises for physico-chemical investigations were made in the Adriatic, and researches on the currents of that sea have also been carried out by means of 685 couples of drift-bottles, set free in 1912–14, 32 per cent. of which have been recovered. Six biological cruises were made during the years 1912–14 in the neighbouring seas; a list of the publications resulting from these is given. A short account is added of the Royal Italian Aerological Service.

IN the *Atti dei Lincei* (vol. xxvi., (1), p. 9) Dr. R. Perotti describes his examination of samples of bread damaged by the attacks of fungus growths which he refers to *Oospora variabilis*, Lindner. In the sample submitted every hole in the bread was carpeted over with a milk-white growth which rendered the bread unfit for food. By experimenting with cultures, the author has proved that infection takes place through the leaven, and he finds that thorough baking at a sufficiently high temperature, especially with small loaves, prevents the growth, while incomplete cooking in a cool, damp oven is favourable to development. Moreover, the leaven should be carefully prepared and stored, so as to avoid risk of infection.

FROM observations made by Dr. B. Grassi and M. Topi, under the direction of the Italian Ministry of Agriculture, and described in the *Atti dei Lincei* (vol. xxvi., (1), p. 5), it would appear that the phylloxera of the vine has undergone considerable variation, different races having developed which infect varieties of vines growing in different localities. The existence of such varieties had been previously noted by a previous writer, who proposed the name *pervastatrix* for the phylloxera attacking the vines of certain districts. In the present experiments, which date from 1914, numerous cases are described in which galls taken from one selected vine failed to infect other varieties. For example, on being infected with galls from Ventimiglia, the infection developed regularly on two varieties of vine, while on three others it completely failed to develop, and somewhat different results were obtained with galls from Arezzano.

AN account of *Hedychium coronarium* growing in the wild state in the States of Rio and Parana, Brazil, is given in *Kew Bulletin*, No. 3, by the late Mr. Clayton Beadle, whose recent death is much to be deplored. Mr. Beadle had taken great interest in Hedychium as a plant for paper-making, and his journey to Brazil was undertaken with the object of studying the growth of the plant under natural conditions. The plant grows in abundance in the low-lying lands, especially near Morretes, in Parana, the stems reaching a height of as much as 12 ft. Mr. Beadle found it was possible to make a very fair white paper from the stems growing in Brazil.

THE occurrence of boreal types in the southern hemisphere is always a matter of interest to biologists studying animal and plant distribution, and the occurrence at the Cape of Good Hope of the composite genera, Matricaria and Chrysanthemum, is worthy of note. Six species of Matricaria and five of Chrysanthemum are recorded from the Cape region by Mr. J. Hutchinson in *Kew Bulletin*, No. 3. Both genera belong to the northern regions, Matricaria having only one species in tropical Africa, while Chrysanthemum, except for the Cape species, does not occur south of the Canary Islands. The five species at the Cape are all endemic, and one of them, with fleshy stems and leaves, from Namaqualand, is here described for the first time. The Matricarias are also all endemic, with very restricted distribution.

THE annual report of the Agricultural Department, Dominica, for 1916–17 is, as usual, a document of considerable interest. Unfortunately a great deal of damage by the hurricane of August 28, 1916, is recorded, and there is a long account of the steps taken for the treatment of the storm-damaged lime trees, some photographs of which are reproduced. Reference is also made to the varietal forms of *Pimenta acris*, the bay-oil tree. As in the case of Camphor, there are two or more forms, one of which gives the valuable economic product, while the other is of little value. The Camphor tree, which has been planted in many of our English Colonies, appears to yield oil only and no solid camphor, and reference is made to this in the *Agricultural News* of June 16, 1917, and in other periodicals. Both in the case of Pimenta and Camphor it is scarcely possible to separate the two forms on morphological characters.

IN the *Annals of Botany* (vol. xxxi., No. cxxii., pp. 181–87) Dr. Spencer Pickering gives a summary of his investigations of the effect of one plant on another growing near it. These experiments originated in 1895 in his well-known observations on the effect of grass on fruit-trees. Proceeding from this complex case to the simplest conditions, conclusive evidence of toxin production in the soil by the growing plant has now been obtained. The deleterious effect of one growing plant on another appears to be a general phenomenon. By means chiefly of pot experiments the following plants have been found susceptible to such influence:—Apples, pears, plums, cherries, six kinds of forest trees, mustard, tobacco, tomatoes, barley, clover, and two varieties of grasses; whilst apple seedlings, mustard, tobacco, tomatoes, two varieties of clover, and sixteen varieties of grasses have been found capable of exercising toxic effects. In no case have negative results been obtained. The magnitude of the effect varies greatly, but the average effect in pot experiments is placed at a reduction of roughly one-half to two-thirds of the normal growth of the plants. The evidence that these detrimental effects are due to toxin production is regarded as conclusive. A plant affects its own kind just as much as any other kind, and hence it follows that the toxin formed by any

individual plant will affect that individual itself. The practical bearing of these observations in various directions is discussed in the light of experimental results.

AN interesting example of the awakening of a national consciousness and political organisation among a nomadic people is recorded in *La Géographie*, vol. xxxi., No. 5. In February of this year the Lapps of northern Norway and Sweden held a conference at Trondhjem, to consider certain questions affecting their interests. More than a hundred, including several women, attended, and the conference claimed to be representative of all the Lapps in Scandinavia. The chief complaint of the Lapps, and one felt more in Norway than in Sweden, is that their grazing grounds are being steadily restricted, and they themselves frequently fined heavily for damage done to crops by their reindeer. This is merely one expression of the usual contest between nomadic and settled people whose territories adjoin. The conference resolved to press for modifications of the Norwegian law of 1883, by which penalties must be paid for damage to crops, and to demand reserves where reindeer can be pastured without interference.

THE winter of 1917 in Norway and Sweden is the subject of an article by M. Charles Rabot in *La Géographie*, vol. xxxi., No. 5. Scandinavia, like other parts of western Europe, experienced a severe winter, with temperatures considerably below the average. The most interesting part, however, of M. Rabot's article deals with the unusual ice-conditions in the Baltic in the first three months of the year, and their effect in hampering German shipping with Sweden. From the middle of January to the end of March the ports on Christiania fjord, including Christiania, were blocked with ice, and often quite inaccessible. For two months the Kattegat was full of ice, and the Sound virtually impassable; even an ice-breaker nearly came to grief. The ports of southern and central Sweden, as far as Stockholm, during all the winter months were only kept open with the help of ice-breakers. In normal winters these ports may be closed to sailing vessels, but are open to steamers. The ferry-boats from Helsingborg and Malmö to Elsinore and Copenhagen suffered frequent and long interruptions, and Oxelösund, the port for shipping Swedish iron-ore to Germany, was practically closed for two months.

IN the September number of *La Science et la Vie* Signor Funaioli, engineer of the Società Boracifera di Lardarello, gives an interesting account of the utilisation of the natural steam from the volcanic area of Tuscany, and of the manufacture of boric acid and borax. The highly saturated steam issues from the ground often at fairly high pressures, but for purposes of conversion it is utilised for heating a series of tubes containing water, the steam pressure in these tubes being two atmospheres (say 30 lb. per sq. in.). The steam drives low-pressure turbines, which in turn are coupled to alternators. The steam and water of these "soffioni," as they are termed in the vernacular, contain quantities of boric acid, which is concentrated in a special apparatus and gives a product of about 99 per cent. purity. The acid, treated with sodium carbonate, gives borax, which is manufactured in the form of crystals and powder. Ammonium carbonate is also manufactured, the carbonic acid necessary for the process being also derived from the "soffioni." Prof. Nasini, the chemist in charge of the research department of the establishment, is now carrying out investigations on the radio-activity of the gases of the "soffioni," and on the separation of the helium, which is another element present.

REPORTS have lately been current with regard to a method of making ships "invisible" which is attributed to Mr. Edison. The method is said to consist of a kind of "camouflage," which makes a vessel "absolutely invisible at a short distance." The idea is not new, though possibly some new device may have made its application more successful. The difficulty as regards submarines lies in the fact that to a submarine periscope every vessel is seen against the sky, and usually "hull down." A vessel disguised by camouflage may therefore be "invisible" against a background of water, and yet very obvious to a submarine observer, who sees it against a varying sky. Much can, no doubt, be done to deceive the submarine as to the course of the vessel by suitably "breaking up" its outline, and this seriously affects the aim of a torpedo. But the problem of naval camouflage remains quite different from similar problems on land, where a definite background can be counted upon.

MESSRS. ARNOLD AND READ showed in 1914 that two carbides, Fe_3C and WC, are probably present in tungsten steels. Messrs. Kotaro Honda and Murakami conclude, in a research just published, that these can exist either as a double carbide or as two carbides in magnet steels according to the heat treatment. If the steel is heated to from 800°–900° C., and then slowly cooled, a double carbide is formed. Above Ac_1 this decomposes into its components, but both remain dissolved in the austenite. On heating still further, the tungsten carbide begins to dissociate into tungsten and carbon, and the dissociation is complete at about 1100° C. On cooling the steel from above this temperature, Ar_3 begins at about 550° C., and Ar_1 at 500° C. On reheating to 900° C the double carbide is once more formed. Magnet steels cooled from 900° C. deposit granular ferrite and eutectoid. If, however, they are cooled from above 1100° C. the ferrite is needle-shaped. The granular ferrite is regarded by the authors as pure iron, while the needle-shaped ferrite is a solid solution of tungsten in iron. These conclusions agree with those drawn from the magnetic experiments. Some specimens exhibiting the Ar_1 change, partly at 700° C. and partly at 500° C., have both granular and needle-shaped ferrite. In some of the above conclusions the authors merely confirm well-established work done in England and France several years ago.

THE Journal of the Department of Agriculture and Technical Instruction for Ireland (vol. xvii., No. 4) contains the report of a lecture entitled "Chemistry in Industry," delivered by Prof. G. T. Morgan to a gathering of teachers. Perhaps even yet the general public does not realise the fundamental importance of the application of chemistry to industry. If so, Prof. Morgan's answer to the question: What part does chemistry play in satisfying the two primary wants of mankind, food and shelter? may perhaps serve to make the whole subject more "understanded of the people." He points out that scientific agriculture is absolutely essential in food production, and that the exhaustion of soils following intensive cultivation must be made good by artificial fertilisers. The methods of preparing calcium nitrate used in Norway and that of Kilburn Scott are described, and stress is laid on the necessity of burning coal in a rational manner so as to recover all the ammonia and other by-products. The production of superphosphate by the use of nitre-cake and the recovery of potash from the flue-dust

of cement kilns are mentioned. As regards the provision of shelter, Prof. Morgan points out that in the production of Portland cement the chemist is supreme, and very few stable structures are built nowadays in which it is not employed. Glass is another important material in building construction of which the manufacturer requires the continual intervention of the chemist. Chemistry is no less important in industries providing the munitions of war. As the raw materials for the latter are obtained from coal-tar, which also supplies the organic compounds necessary for the production of dyes and drugs, the latter industries become interdependent with that of munition-making. The synthesis of one dye or drug is not only important *per se*, but also frequently the incentive in the synthesis of others. Thus, since the synthetic production of indigo many other vat dyes not found naturally have been produced.

WITH reference to our note on ferro-concrete ships (NATURE, October 11, p. 114), *Engineering* for October 19 contains an interesting account of the launch of the ferro-concrete ship *Beton I.*, with illustrations from photographs. As indicated in our former note, the ship was built bottom upwards and launched in this position. On taking the water, the air contained in the structure caused the draught to be comparatively small, the water plane was therefore large, and the vessel was in stable equilibrium. On permitting some of the air to escape, the vessel sank in the water; owing to the shape of the bottom, the area of the water plane was thus reduced considerably. Ultimately a draught was reached in which the centre of gravity was above the centre of buoyancy, and an upsetting couple was established which caused the ship to turn right side upwards, in which position stable equilibrium was again attained. The uprighting, to begin with, proceeded slowly, and accelerated in the intermediate stages in which the couple was greatest, and then again more slowly. The turning took place very neatly, without any shock, and the vessel had then, of course, to be emptied of water.

AMONG the forthcoming books of Mr. Humphrey Milford, of the Oxford University Press, are the following:—"Agriculture in Berkshire," J. Orr (a survey made on behalf of the Institute in Agricultural Economic, University of Oxford), illustrated; "A Weather Calendar," Mrs. H. Head, with a bibliography; "Dr. John Radcliffe, his Fellows and Foundations," J. B. Nias; "Dynamic Psychology," R. S. Woodworth (The Jesup Lectures); "Aristotle: Meteorology," edited by F. H. Fobes; "The Principles of Acidosis and Clinical Method for its Study," A. W. Sellards; "The Self and Nature," De Witt H. Parker; "The Problem of Space in Jewish Mediæval Philosophy," I. Efros.

THE new announcements of Messrs. Longmans and Co. include:—"Rhododendrons and their Hybrids," by J. G. Millais, with coloured plates by A. Thorburn, B. Parsons, E. F. Brennand, and W. Walker; "Mysticism and Logic and other Essays," by the Hon. B. Russell; "Reality and Truth: a Critical and Constructive Essay concerning Knowledge, Certainty, and Truth," by the Rev. Prof. J. G. Vance; and "The Works Manager To-day," by S. Webb.

MESSRS. J. M. DENT AND SONS, LTD., will shortly publish in "Everyman's Library" an anthology from the works of the late Prof. William James, which will form an introduction to the writings of the philosopher. The book is edited by Prof. C. Bakewell, of Harvard University.

OUR ASTRONOMICAL COLUMN.

THE HUNTER'S MOON.—The following particulars as to the visibility of the moon during the next fourteen days may be of interest:—

Rises		Souths		Sets		Altitude on meridian
	P.M.		P.M.		A.M.	°
Oct. 25,	2.26	Oct. 25,	7.52	Oct. 26,	1.32	31
26,	2.45	20,	8.43	27,	2.57	37
27,	3. 5	27,	9.35	28,	4.22	44
28,	3.26	28,	10.28	29,	5.47	50
29,	3.49	29,	11.22	30,	7.13	55
			A.M.			
30,	4.19	31,	0.19	31,	8.34	59
31,	4.56	Nov. 1,	1.17	Nov. 1,	9.49	62
Nov. 1,	5.41	2,	2.15	2,	10.50	63
2,	6.38	3,	3.11	3,	11.39	62
					P.M.	
3,	7.42	4,	4. 4	4,	0.16	60
4,	8.49	5,	4.53	5,	0.43	58
5,	9.59	6,	5.39	6,	1. 4	54
6,	11. 8	7,	6.23	7,	1.23	50
	A.M.					
8,	0.15	8,	7. 4	8,	1.39	45

The times along the same horizontal line refer to the same appearance of the moon above the horizon.

Full moon occurs at 6.19 a.m. on October 30, and last quarter on Nov. 6 at 5.4 p.m. It may be noted that the half-moon gives only about one-tenth of the amount of light given by the full moon at the same altitude.

THE ORBIT OF COMET 1914*c*.—A definitive investigation of the orbit of comet 1914*c* (Neujmin) has been made by J. Svärdson (*Ast. Iaktt. Stockholms Obs.*, Band 10, No. 6). The comet was never very bright, but was observed during a period of 182 days, from June 27 to December 22. Corrections have been applied for the perturbations due to Jupiter, and it is concluded that the observations are best satisfied by the following hyperbolic elements:—

$$T = 1914,\ \text{July } 30{\cdot}15783 \pm 0{\cdot}13374 \text{ Berlin M.T.}$$

$$\left.\begin{aligned} \omega &= 14^\circ\ \ 2'\ 12{\cdot}5'' \pm 92{\cdot}4'' \\ \Omega &= 270^\circ\ 18'\ 26{\cdot}7'' \pm\ \ 3{\cdot}3'' \\ i &= 71^\circ\ \ 2'\ 18{\cdot}4'' \pm 10{\cdot}1'' \end{aligned}\right\} 1914{\cdot}$$

$$\log q = 3{\cdot}747131 \pm 0{\cdot}000243$$

$$e = 1{\cdot}003672 \pm 0{\cdot}000296$$

The orbit is remarkable for the exceptional value of the perihelion distance; in this and other respects it shows considerable resemblance to the orbit of the comet of 1729.

MAXIMUM OF MIRA CETI.—This well-known variable star may be expected to reach a maximum about the end of the current month. The magnitude ranges from 2·0 to 9·6 in a period of about 331 days, but the period and magnitude at maximum are subject to variation. The star is now well placed for observation, crossing the meridian near midnight, and thus being above the horizon for practically the whole night. On October 20 the star was of about 4th magnitude.

BRESTER'S THEORY OF THE SUN.—In anticipation of a further volume on the constitution of the sun, Dr. A. Brester has issued the introduction and general conclusions in pamphlet form (La Haye: P. van Stockum et Fils, 1917). As is well known, Dr. Brester does not accept the general view that the surface of the sun is subject to violent disturbances, and seeks to explain solar phenomena on the basis of a relatively tranquil gaseous globe which is practically undisturbed by convection currents. The solar gases decrease in density and luminosity from the centre outwards, but on account of their opacity their light never reaches us. The photosphere is a condensation stratum which is rendered luminous in the same way as a mantle in an ordinary gas flame, while a sun-spot is a perforation

through which the less luminous surface layer of the interior gases becomes visible. The varying frequency of spots is accounted for by supposing that at minimum the heat of the central nucleus is prevented from escaping by a photosphere of relatively great thickness, and that afterwards, owing to contraction, the temperature of the nucleus increases to such an extent that the photosphere becomes attenuated and subject to perforations in the form of spots and pores. Radiation from the nucleus is then facilitated, so that the photosphere again increases in depth, and eventually produces another minimum. The chromosphere, prominences, and corona are regarded by Dr. Brester as effects of a permanent aurora, which is maintained by electrons projected from the photosphere.

THE NEW PHYSICS.

Copies have reached us of five of Prof. Levi-Civita's recent mathematical papers,[1] three of which deal directly with Einstein's theory of gravitation, and suggest some remarks on the aspect of theoretical dynamics, as it appears at present to a comparative layman unable to criticise rival theories in detail. Speaking broadly, we may say that the theory of mathematical physics is based upon a comparatively small number of fundamental differential equations. Until recently time was explicitly or implicitly treated as the independent variable, in terms of which the other variables had to be found; and all phenomena were supposed to take place in a three-dimensional Euclidian space, where we can use the formula $ds^2 = dx^2 + dy^2 + dz^2$ for the distance between two very near points. In the theory expounded by Minkowski and others we have a different formula, $ds^2 = c^2dt^2 - (dx^2 + dy^2 + dz^2)$, where we may regard dt as an element of time, and speak of a "world-point" (x, y, z, t) determined not only by its position, but also by its age. Einstein has developed his gravitation-theory from the general expression, $\Sigma g_{ij}dx_idx_j$ $(i, j = 0, 1, 2, 3)$, assumed for ds^2, where ds is an element of distance in a four-dimensional space. (It may be remarked that in the previous theory, as Minkowski pointed out, we might take dt as a variation of a co-ordinate distance; then phenomenal processes in our space might be regarded as "sections," so to speak, of a four-dimensional system.)

With Einstein's form of ds^2 we can at once use all the known geometrical theory of infinitesimal geometry in four dimensions, and, in fact, the well-known symbols of Riemann and Christoffel directly enter into Einstein's gravitation formulæ. This is a matter of mathematics merely; the most striking fact, from the physical point of view, is that Einstein has used his formulæ successfully to account for the secular motion of the perihelion of Mercury. This does not show that Einstein has said the last word on the theory of gravitation, but it does show that these post-Newtonian theories provide a calculus which gives a better image of actual facts than the purely Newtonian theory seems able to do. The more predictions the new theory can give us, which are verified by experiment, the more we shall be inclined to trust it; and this is quite independent of what we call the "real meaning" of the symbols involved. For instance, Prof. Levi-Civita's paper No. 2 seems to show that if we could produce a sufficiently strong magnetic field, we should find it inducing upon the three-dimensional space to which, so far, our intuition appears to be confined, a corresponding "curvature" measured by $1/R^2$, where R is a length. Assuming that the field is one of 25,000 gauss, the author deduces that $R = \frac{3}{2} . 10^{20}$ cm., or about ten million times the mean distance of the earth from the sun. As he points out, there is little hope of testing this by experiment, but he obtains a formula for the velocity of light, $V = c_1 \exp(x/R) + c_2 \exp(-x/R)$, with a damping coefficient in the second term, which he suggests might come within the range of observation.

Philosophically, the trouble still seems to be about *time*, in the philosophical sense. If we could look at the universe *sub specie aeternitatis*, we might perhaps find our greatest delight in its unchangeable perfection; but so long as we are constrained by processes (even processes of thought), time, *in some sense or other*, is apparently indispensable, and if we evict it from one habitation, we may expect it forthwith to be in occupation of another.

G. B. M.

[1] (1) "Statica Einsteiniana"; (2) "Realtà fisica di alcuni spazi . . ."; (3) "Sulla espressione analitica spettante al tensore gravitazionale . . ."; (4) "Nozione di parallelismo in una varietà qualunque . . ."; (5) "Sulle linee d'azione degli ingranaggi." (1), (2), and (3) are reprints from *Rendic. della R. Accademia dei Lincei* (Rome, 1917); (4) from *Rendic. del Circ. Mat. di Palermo* (Palermo, 1917); (5) from *Atti e Memorie della R. Accad. di Padova* (Padua, 1917).

METEOR ORBITS.

A pamphlet on "The Determination of Meteor Orbits in the Solar System," by G. von Niessl, has just been published in Smithsonian Miscellaneous Collections (vol. lxvi., No. 16, Washington, 1917). The pamphlet is a translation by the late Cleveland Abbe of a paper published in the "Encyclopädie der mathematischen Wissenschaften," dated Vienna, 1907. The author, who has had considerable experience in computing meteor paths and orbits, gives his views as to the mathematical treatment of the subject. He indicates the best method to be followed in determining the radiant and geocentric velocity of meteors and fireballs of which multiple observations have been obtained. Not the least interesting part of his discussion is that in which he deduces the mean errors in the results:—

Mean error of azimuth = 5·8°, 351 observations.

Mean error of apparent altitude = 4·1°, 235 observations.

Mean error of radiants = 3·3°, 43 cases, 537 observations.

Mean error of inclination = 6·5°, 250 observations.

The radiant positions of the chief periodical showers he gives to within 1° of probable error.

Tables are furnished of the average terminal velocity and altitude of meteors, from which he concludes that they "can penetrate deeper into the atmosphere in proportion as they move with a low velocity"—a fact previously well ascertained. With regard to atmospheric resistance, von Niessl's opinion is that direct observations make it probable that the velocity of meteors in the upper atmospheric regions is slighter, while in the lower strata of the air it is greater, than theoretical views.

The masses of fireballs and shooting-stars are discussed from various data. Prof. A. S. Herschel dealt with this part of the subject many years ago, and held the view that a first magnitude meteor is usually a few grams in weight, while the very small meteors are only the fraction of a gram. V. F. Sands found from the Leonids of 1867 that the average mass, or weight, of a meteor equal to Jupiter in brightness was 0·67 gram, while a fourth magnitude object was only 0·006 gram.

Von Niessl finds it necessary to assume decidedly hyperbolic orbits for the majority of meteors, for their "observed geocentric velocity far exceeds the limits for parabolic orbits. Therefore the large meteors in general are undoubtedly of interstellar origin." Schiaparelli arrived at similar conclusions half a century ago

The paper is an instructive contribution to the litera-

ture of a branch of astronomy which has been somewhat neglected in recent years. But some of the data on which von Niessl's conclusions are based are old and inaccurate. There is no doubt whatever that for the trustworthy investigation of various difficult questions affecting the subject more exact, modern, and abundant observations are necessary.

GEOLOGY OF THE WITWATERSRAND GOLD FIELD.

THE Rand mining field is geologically one of the most interesting areas in South Africa, as well as the most important economically. Its general structure has been gradually unravelled by the work of the geologists and miners of the Transvaal; and it has now been investigated in detail by the Geological Survey of South Africa. The results of this survey are shown on an excellent map (Geological Map of the Witwatersrand Gold Field, 3 sheets, 1917) on the scale of 1 to 5000, or almost an inch to the mile. It has not been contoured owing to the inadequacy of the topographic surveys, but as the mining fields are on an area of high plains this deficiency is of little practical inconvenience. The map is mainly the work of Mr. E. T. Mellor, who has prepared also a short explanation of 46 pages summarising the geology of the mining field and including a bibliography of the chief literature. The report classifies the rocks and gold reefs of the Rand. The age of the rocks is so uncertain that no precise correlation with those of Europe is attempted. They are divided into three systems with South African names. The youngest, the Karroo, which includes the famous Dwyka glacial deposits and the coal seams, has yielded many fossils, so that its correlation is at least approximately known. The Transvaal system includes the quartzites to the north of the goldfield, a thick series of dolomites and cherts, and the Black Reef series. The oldest of the three, the Witwatersrand system, includes the quartzites, shales, and conglomerates of the goldfield. These two older systems are unfossiliferous, and whether they are Lower Palæozoic or pre-Palæozoic is uncertain. The author accepts the view that the gold of the Rand is of alluvial origin, and abandons the long popular theory that it was introduced by infiltration as in ordinary lodes. The alluvial or placer theory has been advocated by several geologists, while the majority of the mining engineers have supported the infiltration theory. Probably the most striking feature displayed by the map is that strike-faulting is far more important than had been suspected. The author concludes that the unworked parts of the goldfield are so extensive that the gold-mining industry has elements of "comparative permanency not found in many other goldfields and more akin to those of a base metal district or a manufacturing centre."

ORGANISED KNOWLEDGE AND NATIONAL WELFARE.[1]

THE future of any nation is secure if it lives up to its possibilities. The nation which does this is bound to be a leader among nations and to command world-wide respect. Its national problems will be solved, and solved intelligently and thoroughly. The greatness of a man is in part born in him and in part the product of his environment. According to eminent biologists, he is about two-fifths born and three-fifths made. Similarly, a nation is great according to its resources and according to its development of these resources. And the development of those resources may be accomplished only through organised knowledge.

(1) *The Function of Organised Knowledge.*—Consider for a moment two manufacturing concerns on an equal footing as regards output, but of which one is continually making progress through improvements in manufacturing processes, developing new and valuable products and investigating the fundamental principles underlying all these processes. This firm will in time outstrip the other in every way; the balance, in fact, is a very delicate one, since the results are cumulative. In quite a similar manner, that nation will advance to leadership in which the increase in organised knowledge and the application of that knowledge are greatest. For this reason, interest in research should be as wide as the nation and should cover the whole gamut of problems from administration to agriculture, from medicine to manufacture. For it is only through the solution of individual problems that general principles can be arrived at and the sum total of useful organised knowledge increased.

It is essential that the wide field to be covered be kept in mind, extending over not only physics, chemistry, engineering, and all their branches, but all the biological and mental sciences as well. In the last analysis an increase in knowledge in the field of the *biological sciences* means more and better food, improved racial stock, and improved public health, as well as increased material welfare in all having to do with plants and animals. Increased knowledge of the fundamental principles of the *mental sciences* means increased efficiency in administration, legislation, education, operation, and research. I do not mean mere book learning in psychology, but such a command of the fundamental principles as will assist in the solution of all practical problems. Increased knowledge of *chemistry* means increased ability to utilise raw materials and an improvement in general health and living conditions. One may almost say that the generalised problem of chemistry is to convert the less expensive raw materials, such as cellulose, petroleum, glucose, various minerals and oils, starch, nitrogen of the air and the like, into food, clothing, tools for our use, and means for national defence. An application of the fundamental principles of *physics* in the way of various engineering problems leads to a fuller utilisation of resources and of new products useful to man, makes inventions possible and effective, and adds to the general increase in operating efficiency in every way.

The utilisation of organised knowledge in national welfare comes about both through knowledge itself and the incentive to apply that knowledge. Both ability and incentive are essential to utilisation. So far as knowledge went, we might have made dyes and optical glass many years ago in the United States, but since they could be bought so cheaply there was no incentive to develop the manufacture of such articles. These are cases of ability without incentive. On the other hand, there has long been an incentive for the fixation of nitrogen and for various mechanical devices, but these have not been forthcoming for lack of sufficient knowledge.

In general, in normal times it is perhaps no exaggeration to say that neither the average individual nor the average nation approaches within 50 per cent. of their possibilities. Nothing short of a war threatening the national existence can shake a nation out of its lethargy. Similarly, the average individual cannot be induced to put forth his best efforts without the strongest of incentives. It is unfortunate that this is the case. However, with sufficient attention given to the problem by trained experts in mental science, it is

[1] Abstract of an address given on April 9 to the Associated Engineering Societies of Worcester, Mass., by Dr. P. G. Nutting. Reprinted from *Science* of September 14.

quite possible that at some future date as high as 60 or 80 per cent. of the possibilities may be realised without any appeal to arms for the nation or any unusual incentive for the individual.

(2) *The Increase of Organised Knowledge.*—The research by which organised knowledge is increased will doubtless always be carried on chiefly by three distinct types of research organisations: research by the Government in national laboratories, research by the universities in connection with the work of instruction, and research by industrial laboratories in connection with the interests of manufacturing concerns. Apart from these three main classes of laboratories there will always be large, privately endowed research organisations, dealing with neglected fields of remote commercial interest, private industrial laboratories supported by consulting fees, and co-operative testing laboratories, also self-sustaining.

National, university, and industrial research follow three essentially different lines. There is considerable overlap in field, it is true, but each is centred on a different kind of research. The proper function of *national* research is the solution of such problems as concern the nation as a whole, affecting the general interests of all classes of individuals; it is the custodian of standards, it develops methods of precise measurements and investigation, it is trouble engineer for the solution of very difficult problems or the problems of producing units so small as not to be able to have their own research laboratories. It is the proper guardian of the public health. It solves problems connected with contagious and vocational diseases. It develops methods of making good roads, increasing the fertility of the soil, and stocking waters with fish. National research is of all grades, from that dealing with fundamental principles up to that relating merely to lessening the costs of production.

University research must always, in the very nature of things, be concerned chiefly with the advancement of the various sciences as such, and with the development of the fundamental principles of each science. The best university instruction is along these lines, and investigators and students in close touch with them will naturally have most new ideas in close connection with fundamental principles. University research is necessarily one of small jobs and the best minds, and is without very much continuity. The advanced student is interested in a research just long enough to make it acceptable as a doctor's thesis. The instructor is too burdened with teaching to give more than a margin of time to research. But a very small part of the university research is extended year after year, covering a wide field. This is quite as it should be, the university looking after those fields of research of little commercial value on one hand, and not directly affecting the interests of the nation as a whole on the other, but of fundamental and far-reaching importance to all.

Industrial research takes the middle ground and has already become a distinct profession. It is in close touch with practical commercial application on one hand, and with fundamental principles on the other. Its proper field is anything between elimination of works troubles and the investigation of fundamental principles. The staff of the ideal industrial research laboratory is composed of experts of wide experience who can serve the manufacturing departments in a consulting capacity without sacrifice of time. We may perhaps best summarise the preceding statements by describing the ideal research man and the ideal research laboratory.

Some writers have spoken of the investigator as a rare individual to be sifted out from educational institutions with great care for a particular line of work. My personal opinion is that a large percentage of the men students are fitted for research work if properly started along the right line. The investigator should have a mind at once fertile and well-trained. His mind should be teeming with new ideas, but he should possess unerring judgment to reject those which are not logical or promising. We are often asked what sort of preparation in physics would be best for men intending to take up research as a life work. It has even been proposed to give courses in "applied physics" for the benefit of those intending to take up industrial research. Our invariable reply is that the best preparation for a research man is a thorough grounding in the fundamental principles of his science: physics, chemistry, or whatever it may be. If he has this thorough knowledge of fundamental principles it is safe to say that in any properly organised research laboratory with the proper leadership and companions, such a student will have many times as many useful ideas as he can himself possibly follow up with research. Scarcely anyone who has completed advanced work in a science can read, say, a journal of abstracts without thinking of many problems which he would like to investigate. Fertility of mind is not so much an inborn quality of the mind itself as of the training and association which that mind has had.

The ideal industrial research organisation may perhaps be outlined with a knowledge of its development during the last fifteen years. I shall give, frankly, my personal views on the matter, based on an intimate knowledge of four universities, three professional research laboratories, and a visiting acquaintance, so to speak, with quite a number of others. The ideal industrial laboratory, to my mind, consists of two quite distinct divisions: one taking the brunt of works troubles and testing or making analyses of the material used. The other wing is complementary to this, and deals with the larger fundamental problems encountered, problems requiring skilled specialists and considerable time for their solution. The alternative organisation with a single research laboratory covering both works troubles and fundamental problems is not so successful. The plan in this case is to have considerable research in progress of very little interest to the company, but engaging a staff much larger than required to take care of ordinary works troubles. In this case, when works troubles are many and insistent, as they are wont to be at times, the staff engaged upon fundamental research forms a reserve to be called out occasionally to deal with works troubles. The chief disadvantage of this is that the fundamental work is subject to more or less frequent interruption and cannot be so efficiently carried on. On the other hand, when the research is in two quite distinct divisions, fundamental work is not subject to interruption by works troubles.

Industrial research is pre-eminently fitted to be carried on by team work. This we have developed to a high degree in Pittsburg, and consider very much more efficient than the alternative cell system, where each leading man has a room or suite of rooms to himself and keeps his work to himself. In the ideal organisation two or three men work together on the same large problem or group of problems, the aim being to have a good theoretical man and a good experimentalist working together as much as possible, or even a physicist and chemist in some cases. The characteristic of the team-work plan, however, is the conference system. The five or six men most interested in each line of research meet for an hour each week to discuss the problem in its various aspects, to plan new work, and to consider various interpretations and applications of the results obtained. The ideal conference is not fewer than four and not more than eight men, and includes an efficient stenographer. To one experienced in such team work the results of

getting together are surprising. A good suggestion is no sooner made than capped by a better, and the saving in time and effort is almost incalculable.

The conference system also aids in putting useful results before the other wing of the research division and before the patent department. At each of our conferences are representatives of the other wing of the research division, charged with taking up any results immediately applicable, and a member of the legal department who takes care of any ideas worth patenting. This plan of conferences relieves the scientific men from responsibility for directing the attention of the works or of the patent department to useful patentable results.

So far as national welfare is concerned, in order to increase our stock of organised knowledge we need more teaching by professors and instructors in closer touch with industrial problems. So far as developing research men goes, the ideal instructor is probably an ex-professional research man, and, in many cases, one who has made a reputation or a fortune by his work along industrial lines. Another need is, of course, more research laboratories all along the line. The increase would naturally be among industrial organisations and the expense borne largely by manufacturing concerns, since it is they who reap the chief direct financial benefit.

Another great need is co-operation among the various branches of research: national, university, and industrial. There should be a free interchange of men between such laboratories, and each should be thoroughly familiar with the needs and problems of the other. One great benefit from this war, if it lasts sufficiently long, will be to force co-operation between different branches of research.

(3) *The Application of Organised Knowledge.*—The present national crisis brings home to us the crying needs of the nation in availing itself of the knowledge and ability at its command. Fifty thousand specialists, in applying scientific knowledge to practical problems, as well as scores of research laboratories, have offered their services to the nation. But problems requiring investigation are slow in being developed. Once they are formulated and given to the engineers of the country, few will remain unsolved very long.

It is for the engineer to apply the results of research to practical problems and to carry practical problems demanding general research back to the research laboratories. To the engineer every special problem requires a special application of fundamental principles. Is it too much to hope that the day is rapidly approaching when all great problems, particularly those of our national and State Governments, will be automatically placed in the hands of trained specialists? Not self-seeking politicians, or yet men with mere theories, but engineers with a real command of fundamental principles, men with an unbroken record of big achievements and no failures, men ever ready to stake their all on their ability to handle problems in their specialty.

Prof. Joseph Le Conte, in an address years ago, remarked that each of the great professions first attained high standing when it was taught as such in universities. When so taught, the professional men turned out are no longer quacks, but each has a real command of the fundamental principles in his chosen field of action. The basic relation is that any profession has standing in so far as its fundamental principles have been developed and applied. To retain standing, a profession must be continually increasing its stock of knowledge of fundamental principles through research. The engineer of standing in his profession must not be content with a mere working knowledge of rules of thumb, but must have a real command of basic principles in his chosen field and in related fields. The illuminating engineer, for example, should not only know lighting, but also possess a working knowledge of the laws of vision and of geometrical and physical optics. So the great physician or constructional engineer has a command of his own field and an intimate acquaintance with related fields.

So also with research as a profession, the leaders have not only a taste for research and logical minds clearly to analyse and attack problems with thorough scientific knowledge, but also a knowledge of the principles of research; getting the most out of their own minds, avoiding side-issues, co-operating with their colleagues, and putting their most valuable results in permanent, readily available form. Research is one of the youngest of the professions, and one with a promising future, but let no one enter it without thorough knowledge or a full understanding of its aims and methods. With sufficient attention given to research and to its application, this nation with its great national resources should at once attain and retain a permanent lead among the nations of the earth.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SIR WILLIAM TATEM has given 25,000*l.* for a laboratory at the University College of South Wales, Cardiff.

WE notice with regret that Mr. Bonar Law announced in the House of Commons on October 19 that he feared it would be possible neither to pass the Education Bill this session, nor to give a day for the second reading, unless there was a prospect of passing the Bill. There is little substantial opposition to the essential clauses of Mr. Fisher's Bill, and all the provisions covered by them are "urgently demanded by, and connected with, the circumstances of the war," as Mr. Fisher has said. We trust that even yet the Government may be able to proceed with the Bill.

THE University of Bristol has again benefited from the generosity of the Bristol family of Wills and their interest in higher education. Mr. Henry H. Wills lately purchased the Royal Fort House and grounds, which immediately adjoin the University buildings. This historical house was built and decorated in the eighteenth century by a member of the Tyndale family, descendants of William Tyndale, translator of the Bible. The greater part of this property, as well as some adjoining land, has been conveyed by Mr. Wills to the University for future extensions. The property conveyed covers nine acres, which will give the University a total building area of about thirteen acres. Part of the new site has been marked out for the purpose of the department of physics, and another part for that of a residential college. It is proposed to retain the existing house as part of the group of buildings which will eventually occupy the site. It will be remembered that shortly before the war Mr. H. H. Wills, jointly with his brother, Mr. George A. Wills, placed a sum of more than 200,000*l.* in the hands of the University for the construction and endowment of buildings on another part of its site.

THE governors of the Huddersfield Technical College are appealing for public support to enable them to carry out a large extension of the existing buildings. For many years the college has been seriously overcrowded, whilst in some important branches of local industries, such as woollen carding and spinning, no provision whatever has been made for technical instruction. The chemical and engineering industries of the district are developing so quickly that the need for better accommodation at the Technical College has become very urgent. The scheme contemplates the

building and equipment of new departments for coal-tar colour chemistry and for dyeing; the addition to the textile department of new sections for (1) carding and spinning, and (2) cloth finishing, providing at the same time improved facilities for weaving and testing, along with a textile museum; the extension of the departments of mechanical and electrical engineering, especially as regards facilities for practical and experimental work. Space would thus become available for necessary extensions in other departments. To carry through these proposals it is estimated that a sum of 85,000*l*. will be required. The Technical College should then be in a position to deal adequately with the varied educational needs of the leading industries of the district, both for advanced teaching and for research. The principal donations promised to date are:—British Dyes, Ltd., 5000*l*.; Sir J. F. Ramsden, Bart., 3000*l*.; Mr. J. A. Brooke, 1000*l*.; Mr. J. E. Crowther, 1000*l*.; Messrs. Simon-Carves, Ltd., 1000*l*.; Messrs. Walter Sykes, Ltd., 1000*l*. Furthermore, the Huddersfield engineers have undertaken to provide the complete equipment of the new engineering section.

LAST February, by the passing of the Smith-Hughes Act, the United States embarked on a national scheme of State-aided vocational education. We learn from the *Scientific American* of August 25 that the Act is similar in its features to the Agricultural Extension Act of 1914. There is the same provision for increasing grants, beginning with 340,000*l*. in 1917, and rising to 1,440,000*l*. in 1925. The available money will be distributed among all States which agree to contribute sums equal to their share of the grants and to conform to the terms of the Act. The grant provides for the creation of three distinct funds, viz. for paying salaries of teachers, supervisors, or directors of agricultural subjects; for paying the salaries of teachers of trade, home economics, and industrial subjects; and for training the teachers and other educational workers concerned. The Act creates a Federal Board for Vocational Education, consisting of the Secretaries of Agriculture, Commerce, and Labour, the U.S. Commissioner of Education, and three other members, to be appointed by the President, of whom one is to represent manufacturing and commercial interests, one agricultural interests, and one labour interests. The board, besides administering the Act, will carry out investigations relating to vocational education, co-operating with the Departments of Agriculture and Commerce and the Bureau of Education. There has been some fear in the United States that the spread of vocational training may disturb the principle of compulsory general education But every boy and girl will be required to get the same minimum amount of "book learning" as at present, and those who, under conditions now prevailing, would enter the trades and industries as unskilled labourers will, for the future, receive specialised training that will enable them to command higher wages and make them more useful members of society.

THE address delivered to the members of the United Tanners' Federation at the Leather Sellers' Hall, London, on July 17 last by Dr. Sadler, the Vice-Chancellor of the University of Leeds, deserves the serious consideration not only of the protagonists on classical *versus* scientific education, but also of all who are engaged in industries in which science is a prime factor. It puts with force and precision the necessity of an all-round general education in which science, broadly conceived, shall take its due place in the education of all classes of the people, and especially that it shall be made "a stimulating and energetic force in the education of every boy and girl in our secondary schools," and that whilst not claiming that science, as ordinarily understood, should have the last word in settling our view of life, yet that it should be a powerful ingredient in the intellectual ferment which determines the final judgment. It insists that technical education must be preceded by a good general education, and that it "should include three elements—scientific discipline, a study of processes of manufacture, and the study of the relationships, moral and economic, which should be established between the employer and his subordinates and between the industry and the community as a whole." In short, the address conceives the possibility of such a training being itself the core of a liberal education. The importance of scientific research and of a much closer relationship between the industries and the scientific resources of the universities is strongly stressed. "The gulf between the practical man and the scientific investigator is not yet bridged. To span it will be a costly business." In no country is there need for a more intimate union, for the solution of the grave industrial and social problems which beset us, between those practically engaged therein and the patient, scientific investigator. We are "rich in shrewd experience, but almost barbarous," says Dr. Sadler, in our "conception of the service that science can render to practice."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 8.—M. Camille Jordan in the chair.—E. **Branly**: The electrical conductivity of mica. A detailed account of experiments proving the conductivity of mica in thin sheets (0·003 mm.) when under the electromotive force of a single thermo-element (0·004 volt). A special method of testing the mica sheets for holes is described.—G. A. **Boulenger**: Considerations on the Permo-Triassic reptiles of the order of the Cotylosaurians.—W. H. **Young**: The theory of trigonometrical series.—M. **Guilleminot**: Dosimetry and X-radio-therapy in the services of the Army.—G. **Sizes**: The Pythagorean scale from the point of view of musical acoustics.—M. **Guillery**: The Brinell hardness test of metals. For this test it is necessary that the conditions, size of ball, total pressure, and duration of the pressure should be rigorously defined. The last condition, not fewer than five minutes, is practically impossible under works conditions where some 10,000 tests a day have to be carried out. The author has worked out a method by means of which the time is reduced from five minutes to two seconds, the imprint being the same as if working under the standard conditions. This is secured by working with an excess pressure above the standard 3000 kg., and a machine is figured and described by means of which the desired pressure is automatically realised; 600 tests per hour can be made with one machine, and data are given proving the accuracy of the results to be within one per cent. of the Brinell standard.—L. F. **Navarro**: The Flyde peak and Cañadas cirque of Teneriffe.—R. **Anthony**: The primitive embryonic circulation of the Teleostean fishes; study of the embryo of *Gasterosteus gymnurus*.—E. **Bordage**: The transformation phenomena of larval tissues in reserve tissues observed during the metamorphoses of insects.—MM. **Baudisson** and A. **Marie**: The spondylotherapy of asthenic and post-traumatic vasomotor or commotional troubles.

CAPE TOWN.

Royal Society of South Africa, August 15.—Dr. L. Crawford in the chair.—Sir Thomas **Muir**: Note on the resolvability of the minors of a compound determinant.—J. **Moir**: Colour and chemical constitution (part ii.): the spectra of the mixed phthaleins and of the sulphonephthaleins.

Mixed phthaleins, containing two different phenol residues, one of which is $C_6H_4 \cdot OH$, are made with extraordinary ease by boiling *para*oxybenzophenone-*o*-carboxylic acid with any phenol or amine, whether free or substituted. The spectra of eighteen new phthaleins of this class are described, and the laws governing the colour elucidated. The method is an excellent analytical one for identifying phenols and amines and their ethers and derivatives. The spectrum of phenolthymolphthalein is not exactly half-way between those of phenolphthalein and thymolphthalein. The spectra of five sulphonephthaleins made from "saccharin" are also described, also six more new derivatives of ordinary phenolphthalein. A new general formula for the coloured substances is put forward.—J. R. **Sutton**: Kimberley diamonds, especially cleavage diamonds. This paper is a general and statistical account of the diamonds produced in the mines under the control of the De Beers Company at Kimberley. It describes the outstanding differences in size, colour, and type between the yields of the different mines; speaks of coloured diamonds, bort, and, especially, cleavage diamonds; and advances the view that many diamonds have been naturally broken by the unequal expansion of themselves and mineral inclusions. It appears that brown diamonds have shown a particular disposition to come up broken from the deeper levels of the Wesselton mine (though the ratio of colourless cleavage to colourless stones also increases with depth of mining), but the author doubts the common assertion that brown or smoky diamonds are markedly liable to spontaneous fracture.—S. **Schönland**: The phanerogamic flora of the divisions of Uitenhage and Port Elizabeth. This paper is meant to be a companion to the papers published by the late Dr. Bolus and Major Wolley Dod on the flora of the Cape Peninsula, and by the late Dr. J. Medley Wood on the flora of Natal. There are 2290 species recorded, of which ninety-eight are considered by the author not to be native. They are distributed over 128 natural orders and 712 genera. There are, however, still large tracts of this area unexplored. Most of the localities quoted are contained in about 600 sq. miles, while the total area is about 2500 sq. miles; much of the remaining tract is, however, covered by fairly uniform karroid succulent vegetation.—J. R. **Sutton**: A lunar period in the rates of evaporation and rainfall. This paper directs attention to the possibility of a lunar influence governing the evaporation from a water surface, and a lunar period in the incidence of rainfall. Tables are given showing that as the result of hourly observations of evaporation and rainfall during the 120 lunar months from August, 1899, to April, 1909, rainfall has its maximum frequency about the time of moonrise, and its minimum just after moonset; also that the rate of evaporation has a maximum and minimum, respectively, shortly after the moon passes the meridian above and below the horizon.

BOOKS RECEIVED.

Two Summers in the Ice-Wilds of Eastern Karakoram. By F. B. and W. H. Workman. Pp. 296+3 maps+illustrations. (London: T. Fisher Unwin, Ltd.) 25*s*. net.

University of London. University College. Abridged Calendar. Session 1917–18. (London: Taylor and Francis.)

The Pasteurization of Milk from the Practical Viewpoint. By C. H. Kilbourne. Pp. iv+248. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Modern Propagation of Tree Fruits. By Prof. B. S. Brown. Pp. xi+174. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Elliptic Integrals. By Prof. H. Hancock. Pp. 104. (Mathematical Monographs, No. 18.) (New York: J. Wiley and Sons, Inc.; London, Chapman and Hall, Ltd.) 6*s*. net.

A Text-Book of Inorganic Chemistry. By Prof. A. F. Holleman. Issued in English in co-operation with H. C. Cooper. New edition. Pp. viii+507. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Dairy Cattle Feeding and Management. By Profs. C. W. Larson and F. S. Putney. Pp. xx+471. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11*s*. 6*d*. net.

Rustic Sounds and other Studies in Literature and Natural History. By Sir F. Darwin. Pp. 231. (London: J. Murray.) 6*s*. net.

The Faith of a Farmer: Extracts from the Diary of William Dannatt, of Great Waltham. Edited, with an Introduction, by J. E. G. de Montmorency. Pp. xliii+249. (London: J. Murray.) 5*s*. net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 26.

PHYSICAL SOCIETY, at 5.—A Class of Multiple Thin Objectives: T. Smith.—The Radius of the Electron, and the Nuclear Structure of Atoms: Prof. J. W. Nicholson.

THURSDAY, NOVEMBER 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Reflexion of Light from a Regularly Stratified Medium: Lord Rayleigh.—Two Cases of Congenital Night-blindness: Sir William Abney.—Duration of Luminosity of Electric Discharge in Gases and Vapours. Further Studies: Hon. R. J. Strutt.—Surface Reflexion of Earthquake Waves: G. W. Walker.—Characteristic Frequency and Atomic Number: Dr. H. S. Allen.

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THURSDAY, NOVEMBER [illegible] 1917.

INSURA

STONE W[illegible] THE NEAR EAST.

The Annual of the British School at Athens. No. xxi. Sessions 1914–15, 1915–16. Pp. viii+238+plates xv. (London: Macmillan and Co., Ltd., n.d.) Price 21*s.* net.

THE ranks of scholars and archæologists trained in the British School at Athens have been sadly thinned by the war. It will be difficult to replace G. L. Cheesman, Guy Dickins, R. M. Heath, and W. Loring. To the present volume Mr. Cheesman contributes a translation of a pathetic Greek folk-song, and Mr. Dickins a learned study of Greek art as represented in the so-called "school" of Praxiteles.

The most interesting article is that by Mr. F. W. Hasluck on "Stone Cults and Venerated Stones in the Græco-Turkish Area," which strikes new ground and brings together much useful information for the study of primitive beliefs in the Ægean and its hinterlands. Over the Semitic area stone worship survived later and more generally than among races more prone to anthropomorphism. Here and elsewhere the faiths which succeeded the primitive animism tacitly adopted this form of worship. Islam sanctioned it by allowing the reverence paid by the pagan Arabs to the Black Stone of the Kaaba to be perpetuated on the rather far-fetched hypothesis that the Angel Gabriel had brought it to Mecca. In the same way Christianity has permitted or encouraged it in the case of the Stone of Unction at Jerusalem, and by associating the cult of sacred stones with sacred personages or events. Many stones, again, are valued in a secular way, not necessarily more ancient chronologically, though more openly primitive in spirit, as magic and witchcraft to which this reverence is due are more primitive than religion.

These sacred stones fall into certain well-defined classes.

First we have those selected for their natural qualities, such as the Black Stone of the Kaaba, supposed to be an aerolite. The selection of such stones as objects of veneration often depends upon the unusual material of which they are composed. But in some instances colour is an important factor, as in the case of the Yellow Stones at Constantinople used for the cure of jaundice, or the white stones from Melos or Crete used as milk charms. The principles of sympathetic or homœopathic magic regulate their use.

Next come the pierced stones used in a superstitious way all over the Near East. Mr. Hasluck, with some probability, suggests that their virtue is bound up with the conception of holes as "entrances" or "new starts." All entrances or beginnings mark a new departure, a "change of luck," and the mere act of passage may change the luck of the patient for the better. To this is added the fact that the sanctity attributed to the stone surrounds the sick person with beneficent influences as he makes his passage through it. When the passage itself is too narrow to admit the patient, the difficulty is got over by passing some small object through the orifice. This, by absorbing the virtue of the holy stone, may by juxtaposition transfer it to the sufferer. Thus, at a saints' grave in Monastir, women who desire children pass two eggs through the orifice, and by eating them gain their desire.

Stones with external markings, such as the footprints of a god or of a saint, are naturally revered. Abraham left his footprints at Mecca, the Prophet at Constantinople and Jerusalem. In such cases, also, the dominant faith has taken over the objects venerated by its predecessors. A footprint in Georgia is attributed to a legendary Queen Tamar, to a Christian priest flying from persecution, to a Musalman saint who converted the district to Islam.

Worked stones, again, are often utilised for religious purposes. Islam, of course, has no place for reliefs or statues, and if they are venerated by its adherents it is as the abode of Djinns possessed of power, but this power is evoked by secular magic. The Eastern Church has been [illegible] some extent influenced by the Moslem view of graven or molten images, but reliefs of the Thracian horseman are used as eikons of St. George in Thrace. The so-called Demeter statue is worshipped at Eleusis to secure good crops, on the supposition that the headdress of the figure represents ears of corn. "In all probability," says Mr. Hasluck, "the finding of the statue chanced to coincide with an abundant harvest, the inference was that the talisman was '[illegible]' or favourable." Columns are everywhere [illegible] veneration, the isolation or conspicuousness of the object, and in some cases phallic associations, contributing to secure its sanctity. Stones with inscriptions in an unknown tongue are believed to possess magical powers.

Stones of many kinds have sometimes been treated as survivals of some ancient cult. But the chance of finding a stone venerated by different faiths from ancient times to our own is so slight as to be negligible. Where the evidence adduced in support of such survivals can be properly tested it usually breaks down. Sir W. M. Ramsay describes the worship paid to a stone or altar dedicated to Hermes, and assumes that the worship paid to it was continuous from the Greek period. But the real fact seems to be that it was removed in comparatively recent times to a Turkish cemetery, and its potency arises from its use as a tombstone, and from the fact that it bears an inscription in a tongue not "understanded of the people"; therefore it was assumed to possess magical qualities. A case even stronger than this is that of the Black Stone which used to be preserved at the tomb of Daniel at Susa. It was found about 120 years ago, and was rolled down the river bank by the Dervish who kept the tomb some sixty years ago; then a Frank is said to have blown it to pieces in

search of treasure. Associations such as these were held sufficient to prove that it possessed magical power, and this belief was reinforced when after its destruction a visitation of plague occurred, the bridge at Shuster collapsed, and the Hawizah dam was breached. This was all obviously the result of the desecration of the talisman, so the fragments were collected and buried in the precincts of the tomb. The story, as a whole, is singularly instructive to those in quest of the origins of popular beliefs.

OCEAN DRIFT FRUITS.

Plants, Seeds, and Currents in the West Indies and Azores. The Results of Investigations carried out in those Regions between 1906 *and* 1914. By H. B. Guppy. Pp. xi+531. (London: Williams and Norgate, 1917.) Price 25*s*. net.

THE author of this important work is a well-known authority on ocean currents and the geographical distribution of plants. His earlier writings on the geology and natural history of the Solomon Islands and the Cocos Keeling Islands, and his more recent work on "Plant Dispersal," contain the results of many years' patient and exhaustive investigations in the Pacific region. In the present volume he deals in an equally thorough and careful manner with the numerous problems connected with plant distribution in the Atlantic region and embodies results of great scientific interest.

The dispersal of plants by ocean currents is by no means a new subject of inquiry. Hemsley ("*Challenger* Report: Botany," vol. i.) gives an interesting summary of the literature to 1885. The present author acknowledges that the reopening of the subject by Hemsley was the means of stimulating the activities of himself and later investigators. Clusius first figured some of the West Indian drift seeds and fruits in 1605, though at the time he was ignorant of their origin. Hans Sloane in 1695–97 gave an account of four drift seeds cast ashore in the Orkney Isles. Three of these he recognised as having been seen by him in Jamaica. After the lapse of two centuries the mystery in regard to the origin of the fourth drift fruit (*Sacoglottis amazonica*) was only cleared up about twenty years ago (see NATURE, November 21, 1895). The numerous writers who have dealt with drift fruits on European shores since Sloane are fully enumerated in the third, possibly the most interesting, chapter in the book. The tracks of drift seeds and fruits and the "fan-shaped" distribution of bottle drift are admirably illustrated by a chart of ocean currents (p. 46). The fact is established that the drift brought by the north and main equatorial currents and mingled in the Caribbean Sea is captured by what ultimately becomes the Gulf Stream and conveyed to the western shores of Europe. Careful observation has shown that at least one-third of the drift seeds and fruits floating in the neighbourhood of the Turks Islands, in the Caribbean Sea, have been found on the coasts of Europe. Incidental mention is made of the transport of logs of mahogany and even of live turtles to European shores.

In the fourth chapter the similarity between the West Indian and West African littoral floras is discussed. This may be accounted for by the fact that of fifty-three plants occurring in both worlds 62 per cent. respond to the current test for transport by the main equatorial current.

A detailed account of the large foreign drift seeds and fruits, first of the Turks Islands and secondly of other portions of the West Indies, occupies several chapters. The distribution of each is given and its relative capacity for dispersal by ocean currents.

Interesting observations are made on Rhizophora in the West Indies. In the appendix (p. 502) it is suggested that vivipary of the mangroves might be regarded as due to their endeavour to accommodate themselves to climatic conditions cooler than those that once prevailed in their present habitat.

The chapters on the general character and geological structure and the flora of the Turks Islands embody the most complete account yet published of the natural history of that interesting group, and in the detailed study of the altitudinal range of the indigenous plants of the Azores we have two scientific memoirs of great interest.

It is not possible to devote adequate attention to the chapter on Mr. Guppy's theory of differentiation based on the facts presented in this and previous publications. In regard to the general topic of the geographical distribution of plants, he fully accepts the views of Bentham, Hooker, and Asa Gray so clearly re-stated by Thiselton-Dyer in his contribution to "Darwin and Modern Science." Mr. Guppy admits that distribution becomes purely a problem of the northern hemisphere, and that this removes more difficulties in the study of distribution than any other hypothesis. It is a pleasure to add that the great value of Mr. Guppy's researches during the last thirty years has been authoritatively recognised by the recent award of the gold medal of the Linnean Society.

D. M.

OBSERVATION, PHILOSOPHY, AND TEACHING.

(1) *The Combination of Observations.* By D. Brunt. Pp. x+219. (Cambridge: At the University Press, 1917.) Price 8*s*. net.

(2) *Fundamental Conceptions of Modern Mathematics. Variables and Quantities. With a Discussion of the General Conception of Functional Relation.* By R. P. Richardson and E. H. Landis. Pp. xxii+216. (Chicago and London: The Open Court Publishing Company, 1916.) Price 1.25 dollars or 5*s*. net.

(3) *Revision Papers in Arithmetic.* By W. G. Borchardt. Pp. viii+156+answers xxxii. (London: Rivingtons, 1917.) Price 2*s*.

(4) *Differential Calculus.* By Dr. H. B. Phillips. Pp. vi+162. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 5s. 6d. net.

(1) MR. BRUNT gives an account of the method of least squares, without entering into elaborate descriptions of instruments or experimental methods. The book is not easy reading, but this is principally because the material is chosen from a rather difficult branch of applied mathematics, and modern work is discussed very thoroughly. The proof of the law of error is based on Hagen's hypothesis regarding errors of observation, and a generalised form of it, due to Prof. Eddington, is given on p. 15. Other chapters deal with the case of one unknown, observations of different weight, observations involving several unknowns, conditioned observations, the rejection of observations, and alternatives to the normal law of errors. The three last chapters deal with correlation, harmonic analysis from the point of view of least squares, and the periodogram. This last part is of great interest in connection with the modern work of Sir Ronald Ross and Dr. Brownlee, and a recent paper by Sir Joseph Larmor on what may be called "practical harmonic analysis." There are a great number of valuable references in the book, which is much to be commended.

(2) This volume is the first part of a projected work in thirteen parts, of which a synopsis is given at the end of the book. Judging by the synopsis, the future parts may very possibly be interesting, but, on the whole, this first part cannot be said to be a useful contribution to our knowledge of the fundamental conceptions of mathematics. "It is, we believe," say the authors (p. iii), "the first attempt made on any extensive scale to examine critically the fundamental conceptions of mathematics as embodied in the current definitions." After this extraordinary statement we are not unprepared to find that the contributions of Frege, Russell, and Whitehead are judged merely from a very small part of them, and that a part which, on account of its popular character, does not make any pretensions to finality. Further, the remarks about Frege and Russell (pp. 152–53) are quite superficial and valueless, as well as scarcely true or polite. Apart from this, there are some good features in the book. Thus, the criticism of the usual mathematicians' confusion of sign with things signified, and so on (pp. 2–3, 97–110, 180), is quite good, though it is unnecessarily lengthy and rather superfluous after the weighty and witty remarks of Frege, which Messrs. Richardson and Landis do not mention. Also the remarks on Dirichlet's "definition" of a function (pp. 182–90) are correct, but much too long-winded. There are many other true things, but also many mistaken ones which do not even strike us as honest attempts to get at the truth.

(3) Mr. Borchardt's book is a very useful graduated set of one hundred papers of examples on the usual course of arithmetic from the first four rules up to logarithms and compound interest, and including the measurement of areas and volumes. It is always interesting for a student to come across problems which bear some relation to practical life—housekeeping, the profits or otherwise arising from publishing books, the value of the time of a man of business who finds it pays him to take taxicabs. A suggestion that may be offered is that there might be some problems on the calculation of the amount of income-tax reclaimable on a dividend when the dividend is paid "free of tax." This problem is of great practical importance nowadays. Though the book was published quite recently, we have, so far as we can see, problems about income-tax at pre-war figures (*cf.* pp. 126, 150), but possibly a sign of the times is the problem (p. 154) on British and German rifles.

(4) Dr. Phillips has the very laudable purpose of making of the differential calculus "only a brief text suitable for a term's work," so as to leave "for the integral calculus, which in many respects is far more important, a greater proportion of time than is ordinarily devoted to it." We should have expected, then, a suggestive and "intuitional" introduction to the calculus. We find, however, a treatment rather late in the course of rates of change, velocity, and acceleration in straight and curved paths, which seem by far the most stimulating subjects to anyone approaching the calculus for the first time. It is not strictness of logic that banishes what we would call suggestiveness and pedants would call "rough-and-ready methods." For example, in the treatment of Rolle's theorem (p. 94) we have two pictures pretending to show what may happen if the first derivative of $f(x)$ is discontinuous. In both pictures the points in question are points for which this derivative does not *exist*. Other defects in logic are the way in which "the limit of a function" is treated (pp. 5–6): it should, we think, be pointed out that the value of a function at a definite point need not necessarily be the limit of neighbouring function-values at this point. Also the difficulty about higher differentials when a variable is changed is not satisfactorily put (p. 30). This book should be stringently revised before it is put into a student's hands, and then its shortness might combine with accuracy towards making it a good text-book. φ

OUR BOOKSHELF.

An Introduction to the Physiology and Psychology of Sex. By Dr. S. Herbert. Pp. xii+136. (London: A. and C. Black, Ltd., 1917.) Price 3s. 6d. net.

KNOWLEDGE, it has been said, is not virtue, but it is often on the way to it; and we agree with Dr. Herbert that the time has come for franker and fuller sex-instruction. In regard to sex, it cannot be said that ignorance is bliss; it often leads quite gratuitously to vice and to discoloured views of one of the great facts of life. As a medical man, Dr. Herbert is able to deal with difficult subjects in a very matter-of-fact way, and

while his book will shock a few righteous who need no repentance, and afford erotic stimulus to a few abnormal people to whom even the lilies of the field are "suggestive," it will, we think, be welcomed by teachers, by parents, and by the quite naturally curious adolescents who find in all our highly evolved educational system nothing corresponding with the ancient initiation into the mysteries of sex, and very little corresponding with the ancient disciplines correlated with these.

Dr. Herbert's account of ovum-maturation is no longer quite correct; his reference to Loeb's method of artificial parthenogenesis is not up to date; to call the female organism or sex-cell anabolic and the male katabolic is a false simplicity, for it is a question of ratio, as when Riddle says of pigeons that the ova which show a relatively greater storing capacity and relatively lower intensity of metabolism develop into female organisms. But these are minor points; the bulk of the book is thoroughly competent and sound, and this has been wisely restrained. Its particular excellences are in calling a spade a spade, in considering sex in mankind as the outcome of a long evolution, and in insisting on treating the problems not merely physiologically, but also as problems of psycho-biology.

Insetti delle Case e dell' Uomo e Malattie che diffondono. By Prof. Antonio Berlese. Pp. xii+293. (Milano: Ulrico Hoepli, 1917.) Price 4.50 lire.

PROF. BERLESE's interesting manual deals with the insects and arachnids found in Europe attacking man or damaging his food and belongings. After considering those—lice, bugs, fleas, mosquitoes, Phlebotomus, Stomoxys, and ticks—which suck the blood of man, he proceeds in the two following chapters to give an account of house-flies, blowflies, etc., and of such household pests as cockroaches, psocids, Lepisma, moths, and mites. Under most of the species there is a short description of the adult and of the life-history and habits, and suggestions for the application of deterrents and destructive agents. In several cases, *e.g.* the plague flea, the characters are too briefly given to be of much service.

The fullest accounts are those of mosquitoes and house-flies. The author describes his successful attacks on house-flies by means of a solution of sodium arsenite (2 per cent.) and molasses (10 per cent.) in water, and recommends, as the result of his experience, that this solution should be sprayed, every eight or ten days during the fly season, on plants near houses and on manure-heaps, and that bunches of straw or twigs should be dipped in the solution and hung up outside houses near the doors and windows.

A short final chapter is devoted to spiders, scorpions, pseudoscorpions, and acari, which attack some of the pests before-mentioned.

There are a hundred figures in the text. The legend of Fig. 24 is misleading; the figure represents the head of a larval Simulium, not, as stated, the head of a larval mosquito.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

On an Appearance of Colour Spectra to the Aged.

DURING the latter months of my eighty-ninth year my attention became directed to a circular colour spectrum which appeared to surround any bright light to which my eyes were directed. The condition was new to me. I had never read of its occurrence, and had never heard it complained of by a patient; but on making inquiry of two distinguished ophthalmologists of large experience I found that they had been consulted in similar cases, one of them only by octogenarians, while both mentioned examples in which the appearance had excited grave apprehension and distress. But nothing, so far as I can ascertain, has appeared in print upon the subject; and I am inclined to attribute my own lack of experience with regard to it to the fact that I retired from practice fifteen years ago, and that domestic lighting by electricity, which supplies conditions very favourable to the production of the appearance in question, has in the meantime become increasingly prevalent. I will endeavour to describe what I see.

If I look steadily at an ordinary electric filament light, about 10 ft. distant from my eyes, it appears to be surrounded by a vivid colour circle about 2 ft. in diameter, with the red band external, the blue internal, the yellow intermediate. The band appears to be about 6 in. in width, so as to be quite clear of the light itself, from which its inner margin appears to be about 6 in. distant. If I light a wax match and hold it in my hand, the colour circle around the flame appears to be about as large as a florin, while that around a full moon is very large and of very brilliant colours. The appearance is most striking when the light is near enough to be vivid, and yet distant enough to fall upon the eye in a slightly divergent pencil, a result well obtained by seeing in a mirror, at 10 ft. from my eyes, the reflection of an electric lamp 10 ft. from the mirror. This arrangement furnishes a circle about 3 ft. in diameter, both larger and better coloured than if I look directly at the lamp itself.

I do not think that the optical condition of my own eyes has any bearing upon the matter, as the presence or absence of spectacles makes no appreciable difference of luminosity or of colour; but the facts are that my right eye has a total H. of 2 D., with 1 D. more in a nearly horizontal diameter, and my left a total H. of 2·50 D., with 1·50 more in a similar diameter. For the last forty years I have constantly worn fully correcting spectacles, with an increase in the lower halves of the lenses for presbyopia, as it gradually became established, and my vision is, and always has been, perfect. I watch with pleasure the evolutions of distant and lofty aeroplanes, and I read "brilliant" type with facility.

If a strong light is brought sufficiently near my eyes to produce active contraction of the pupils the colour circle does not appear, but it springs into existence as the light is moved a few feet away and the pupils are suffered to expand. In like manner, the colour circle is obliterated when I look at the moderately distant light through a pinhole opening in a card or thin metal disc. The facts appear to be that when the eye receives only a small pencil of nearly parallel rays these are sufficiently refracted in the ocular media to be united in a focus upon the yellow spot. When it receives a larger pencil, the outer portions of which will be

more or less divergent, these portions are not sufficiently refracted to unite upon the centre, but reach the surrounding parts of the retina in the order of their refrangibility, red external, blue internal, yellow intermediate.

The cause of the colour phenomena, therefore, is diminished refracting power of some of the ocular media, and in this relation it is natural to think first of the crystalline lens, on account both of the complexity of its structure and of the well-known fact that it is liable not only to lose its transparency and elasticity in old age, but also to acquire a yellowish or brownish tint. It has been assumed, but, so far as I know, without evidence, that such colour changes are of almost normal occurrence in old age; and, some eighty years ago, an ingenious quack traded upon the suggestion that they were not only normal, but also useful, and placed upon the market, at a high price, spectacle lenses professedly made of clear amber and supposed to be highly advantageous to old people. More recently Dr. Liebreich amused the Royal Institution by a lecture in which he maintained that the peculiarities of Turner's later colouring were due to the gradually deepening yellow of his crystalline lenses. I have, of course, removed many yellow or brown lenses in cases of senile cataract; but I know of no evidence that the healthy lens of an accurately seeing eye changes its colour with age, and I believe that my own perception of all shades of colour remains entirely accurate, and affords satisfactory evidence of complete lenticular colourlessness and transparency.

The vitreous body does not, I think, either display any change of colour as an incident of advancing life, or take any active part in refraction, and my observations lead me, at least in my own case, to dismiss the corneæ from consideration. My spectrum rings are too constant, and too uniform in size, constitution, and colour, to be due to a structure liable to be affected by atmospheric, secretory, or compressive changes. I have kept my eyes open as long as possible, have compressed them with and through my eyelids, have rubbed the eyelids themselves, but, whatever I do, the colour rings remain unaltered. In a word, I have fallen back upon the lenses themselves as the immediate causes of the phenomena, and the question that next arises is whether these phenomena justify any apprehension of diminution or loss of lenticular transparency—in other words, of cataract. I think not. I have carefully examined my own eyes by looking at various sources of light, and at white clouds, through minute slits or minute circular openings in metal discs, and I do not discover any traces of striæ of opacity. The usual shadows are cast upon the retina by minute cells or particles in the ocular media—the shadows so minutely described by the late Dr. Jago in his book on "Entoptics"—but beyond these there is nothing.

I have come to regard the colour rings mainly as an accidental result of unimportant lenticular conditions, the effects of which are intensified by the use of electric light, and which may be dismissed from consideration so far as the quality or the maintenance of vision is concerned. They appear only when the gaze is directed towards the luminosity furnishing them; and they may, I think, be wholly disregarded. I shall be happy if my experience can afford relief from anxiety to any contemporary or other persons to whom such rings may have caused uneasiness.

R. BRUDENELL CARTER.

An Optical Phenomenon.

THE phenomenon described by Capt. C. J. P. Cave (NATURE, October 18, p. 126) is one of the many instances which support Hering's "Theory of the Processes in Living Substance." According to this theory every kind of living substance is subject to two reciprocal forms of change, the one constructive or "assimilative," the other destructive or "dissimilative." (These terms are nearly synonymous with Gaskell's more characteristic, though not quite classical terms, "anabolic" and "katabolic.") Every effective stimulus causes one or other of these changes, and at any given instant the living substance is in a state of unstable balance between the two, like a flying animal or machine between the force of gravity and the lifting force. *In the cessation or diminution of any stimulus, the living substance tends to return towards the state of balance from which that stimulus changed it.*

The theory applies especially to the very unstable substances of muscle, nerve, and sense-organ. Now, if an effective stimulus be removed from a sense-organ, the return of the sensitive substance towards the former state of balance, being a reciprocal change, produces a reciprocal sensation if such be possible, as when the removal of a hot body from the skin causes a sensation of cold, or the removal of a coloured object from the field of vision causes an after-image of the complementary colour. So the cessation of the stimulus of a moving image on the field of vision causes reciprocal changes (of complex character, no doubt) in the nerve-tissues concerned, which are interpreted at headquarters as reciprocal motion.

An English translation (by Miss F. A. Welby) of Hering's paper describing this most interesting and important theory may be found in *Brain*, 1897, p. 232.

F. J. ALLEN.

Cambridge, October 20.

Native Grasses of Australia.

I REGRET that in my "Age of Mammals," published in 1910, the statement is erroneously made that native grasses are absent from Australia. I am unable to find my authority for this statement, and I regret that it has been quoted in a recent text-book of geology by my friend, Prof. H. F. Cleland.

Prof. E. W. Berry, botanist at Johns Hopkins University, informs me as follows:—"There are certainly plenty of native grasses in Australia; in fact, there is quite a large number of genera confined to that country or to Australia and New Zealand, which is unusual for this group, since grasses, as shown by their present distribution, are an old stock, and enjoyed a nearly world-wide radiation probably as early as the Upper Cretaceous. Possibly the multiplication of turf-forming species was not accomplished until the progressive desiccation of the climate in certain areas at a later time, and I think that this distinction has been more or less overlooked. Some of the genera of grasses confined to Australia are:—Neurachne, Plagiosetum, Xerochloa, Potamophila, Microlæna, Tetrarrhena, Amphipogon, Echinopogon, Dichelachne, Diplopogon, Pentapogon, etc."

HENRY FAIRFIELD OSBORN.

The American Museum of Natural History, New York, September 27.

Vegetable Pathology and the Vicious Circle.

IN animal pathology disease is frequently complicated by reactions which aggravate the primary morbid process, and so establish what is known as a "vicious circle." This process *vires acquirit eundo*, and may lead to the perpetuation of disease, to the destruction of an organ, or even to the termination of life. I should be glad to know whether any examples of such "vicious circles" are met with in vegetable pathology.

JAMIESON B. HURRY.

Westfield, Reading, October 26.

COAL-GAS FOR MOTOR TRACTION.

ONE of the results of the scarcity of petrol has been that inquiry has been stimulated into other possible fuels for power purposes on motor vehicles. Benzol, being a home-produced fuel, would have been an admirable alternative, but the entire output is already required for other more urgent purposes. Alcohol, too, could have been used, had it been available, but too little is produced in this country to meet the demand, even if other difficulties had not stood in the way. The only available alternatives are paraffin and illuminating gas. Paraffin can be used quite well on slow-moving vehicles, provided that the load is reasonably steady, and that a small quantity of petrol is available for starting the engine with reasonable dispatch; but this, again, is not home-produced.

The problem is essentially a war one, and it arises from the present limitation of ocean transport. The alternative fuel must, therefore, be one which not only can be, but actually is now

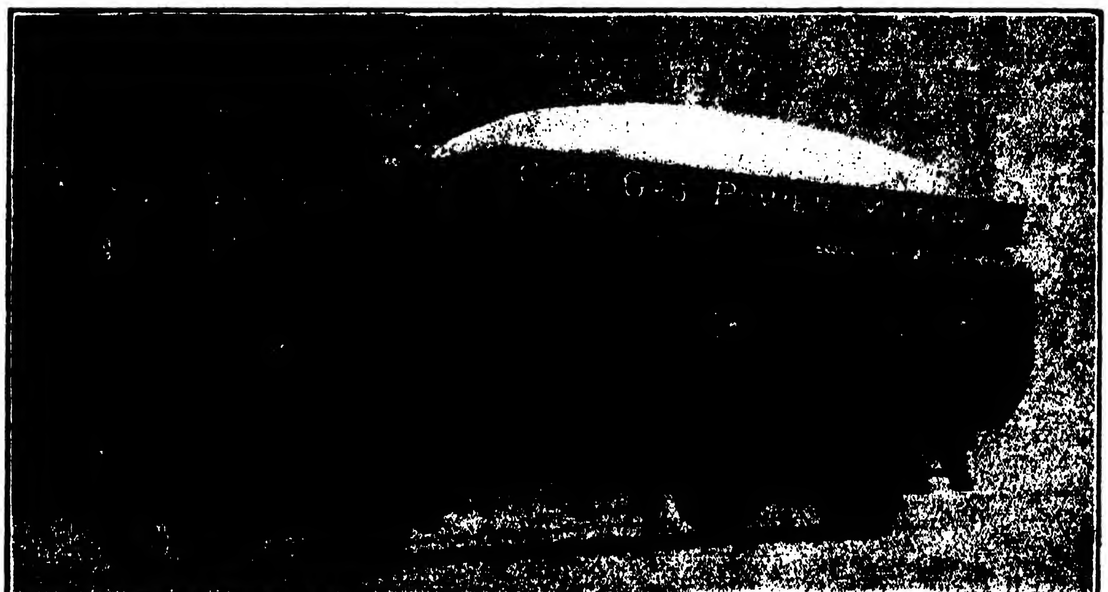

Fig. 1.—A petrol vehicle adapted for coal-gas propulsion.

being, produced in these islands. Coal or its derivatives is clearly indicated. Benzol is not available for the reason already given; coal could be used in some form of "suction producer," thus affording a supply of "suction gas"; but a satisfactory producer capable of attachment to a car has yet to be developed. Coke has been satisfactorily employed on heavy vehicles, but the process, being one of external combustion, is not adaptable to the great majority of vehicles. Hence, by a process of exhaustion, illuminating gas is arrived at as the only possible present alternative. It has, however, to be remembered that any such alternative fuel must be used in a way that does not require additional equipment making any substantial demand on raw materials. For this reason it is scarcely worth while to adopt any plan which requires the gas to be stored at pressure, since this would need storage cylinders of steel. The scheme must be one for carrying the gas at atmospheric pressure, or at best at pressures but little higher.

Such a scheme is practicable, and has already been applied to some hundreds of vehicles. The main drawback is the bulk of the storage bags. A gallon of petrol has a net calorific value of 79,000 pound-calories, and the mean calorific value per cubic foot of petrol vapour with enough air for complete combustion is 56 pound-calories. Coal-gas has a calorific value of about 350 per cubic foot, and the mean calorific value per cubic foot of gas and air for complete combustion is 58. It will be seen from these figures that an engine of given dimensions should yield the same power on either fuel, assuming the thermal efficiencies to be the same (as they probably would be); and that 1000 cub. ft. of coal-gas would contain the same calorific value as about $4\frac{1}{2}$ gallons of petrol. If, therefore, the gas costs, say, 3*s*. per 1000 cub. ft., the equivalent cost of petrol would be 8*d*. per gallon. This serves to show that a very large financial economy arises from the substitution.

The remaining consideration is the bulk of the storage chamber. Now, 1000 cub. ft. are seen to be equivalent to $4\frac{1}{2}$ gallons of petrol, and although the road tests so far made give a rather larger gas consumption, there is no reason why an equivalence to 4 gallons of petrol should not be attained. On this basis a car running twelve miles to the gallon of petrol would run forty-eight miles to 1000 cub. ft. of gas. A Ford car can carry about 250 cub. ft. of gas on the roof, and as this is equal to exactly 1 gallon of petrol, the distance run between fillings would be about twenty miles. If the gas could be contained in strong bags capable of withstanding 15 lb. per square inch (gauge pressure), this distance would be doubled.

The method is seen to be useful only for running short distances out and home, or for use on roadways having supply stations about every ten miles. Repairs to the engine would be minimised rather than increased by the use of gas instead of petrol; the sparking plugs would need less attention, and the cylinders would not require to be cleaned out so frequently. Moreover, the change over from the one fuel to the other is of the simplest; a pipe is taken from the holder to a tap near the driver, and from that point direct to the engine side of the existing carburettor.

As is well known, it is now customary at some engineering works for automobile and aircraft engines to be "run in" with coal-gas as fuel; moreover, it is within the writer's recollection that on the breakdown of a power station in the very early days of petrol-engine construction the whole machinery of a workshop was run by a petrol engine fed from the gas mains. This instance afforded an insight into not only the adaptability of the engine, but also, on comparing the size

of the shop engine and its temporary substitute, the intense concentration of considerable power into very small space which the introduction of this engine brought about.

Although in a recent report by the British Commercial Gas Association there is given information as to the weight of steel cylinders for containing gas at pressures at 20, 25, and 120 atmospheres, there is little reason to expect supplies of these containers to be available in any quantity likely to affect the problem; even if they were, these figures show that the storage capacity for the equivalent of 4 gallons of petrol would weigh between 1000 lb. and 2000 lb. (depending on the pressure). So that on dead weight alone they would be at a great disadvantage compared with the atmospheric pressure, or "Beeston," system.

The illustration shows the vehicle which is stated to have been the first to be run on this system. The movement has since spread very rapidly, and reference to the technical Press shows more than a dozen firms making the fabric containers and above a hundred firms offering to fit them.

H. E. Wimperis.

A NATIONAL FOOD POLICY.[1]

THE greatest war of all time is slowly but surely having a bound set to its ravages by the limitations of the productive effort of the world's agriculture. The steady drain of man-power, increasing difficulties of transport, and unfavourable climatic conditions have all combined to curtail the world's food supplies, whilst in many countries the spectre of famine begins to loom ominously in the distance. Few nations have fared better in this respect than ours, but our difficulties are steadily increasing, and there is widespread anxiety as to the exact position at the moment and our prospects for the near future. What is our normal margin of safety? How do we stand to-day? How can we best avoid a worse condition? Such are the questions to which all would have an answer, though few realise how difficult it must be to provide. It demands the combined skill of the statistician, the physiologist, and the agricultural expert, and the fortunate combination of these qualities in his person thus confers upon the estimates and conclusions of Prof. Wood a title to consideration which probably none other could claim.

The report of the Food (War) Committee of the Royal Society (Command Paper, Cd. 8421) has previously indicated that our pre-war average food consumption, as measured by its work-producing power, was about 15 per cent. above the level commonly accepted by physiologists as adequate for the maintenance of complete efficiency. In view of the increased proportion of the population now engaged in strenuous work, this margin would doubtless be no more than 5 to 10 per cent. to-day, even were supplies of food no less. The report further showed the predominating position of cereals and meat in the national dietary. Cereals alone contribute more than one-third of the work-producing power of the diet of the average "man," whilst in the diet of the manual labourer the proportion will often be nearer two-thirds. Bread and meat together account for more than one-half of the work-producing power of the nation as a whole.

If our margin of possibility in food economy is but this 5 to 10 per cent., it is obvious that our war food policy must embrace more than an anti-waste campaign, urgently desirable though that may be. The main problem is to secure the bread supply. Unfortunately, the two most obvious solutions, increased importation and greater home production of wheat, are not easy of attainment and become progressively more difficult as the war continues. It does not seem likely that the utmost effort in these directions will produce any very considerable immediate result. Prof. Wood sees a more practicable solution in the diversion of large quantities of bread-corn and other food-stuffs from animals and industry to human consumption. Of our pre-war annual supply of seventeen million tons of grain of all kinds, little more than five millions served directly for human food, whilst animals consumed above nine millions, the rest going for seed, for brewing, distilling, and other industries. Basing his argument upon the fundamental wastefulness in times of scarcity of the conversion of bread-corn into meat, as illustrated by the fact that the most efficient of meat-producing animals, the pig, produces no more than 1 lb. of dry human food for 12 lb. of dry grain consumed, and after reviewing carefully the significance of each of the cereals for animal feeding, Prof. Wood concludes that fully three and a half million tons of cereals might be transferred from animal fodder to human food, with a resultant net gain of two and three-quarter million tons of dry human food, and a reduction in the necessary import of grain for the year 1917–18 of three million tons below the pre-war figure.

After a detailed estimate of the fodder of all kinds likely to be available for live stock, Prof. Wood concludes that, broadly speaking, despite the diversion of fodder suggested, it will be possible to maintain our live stock, but it will not be possible to produce so large a total output of growth, meat, milk, and work. Full provision for work and milk must, however, be regarded as indispensable, so that the brunt of the shortage must be borne by the meat-producing stock. Pigs and poultry are the most economical converters of fodder into animal food, but, unfortunately, their diet consists largely of grain or grain products which can no longer be spared. Sheep are fairly economical food-producers, consume mainly grass, hay, and roots, and produce wool as well as food, so that they may certainly be encouraged. Beef production, however, as normally carried on, is a very wasteful process, owing partly to the slowness with which ordinary cattle mature, and partly to the extreme to which the fattening process is commonly carried. By extending the use

[1] "The National Food Supply in Peace and War." By Prof. T. B. Wood. Pp. 43. (Cambridge University Press.) Price 6d. net.

of early maturing breeds and killing off at an earlier stage of fattening than has been customary, the result will be a great economy in concentrated feeding-stuffs, and such a reduction of the head of cattle can be effected as will equalise the demand for feeding-stuffs and the supply. When the total reduction in live stock becomes such that the normal meat supply can no longer be maintained, recourse must be had to increased importation. Should this step prove necessary, it will obviously save tonnage to import meat rather than fodder.

Agriculturists will find many points for criticism in the details of Prof. Wood's estimates, which are admittedly and of necessity only rough approximations in many particulars, but such criticism can scarcely shake the soundness of his general conclusions.

Too much importance cannot be attached to Prof. Wood's appeal for a careful examination of the results of the methods which have been used in Germany for carrying out a policy framed on similar lines, so that we may avoid the mistakes which have been in a great measure the cause of the food troubles of Germany. It is suggested that the essential features of a successful policy must comprise, first, the prohibition of the use of sound potatoes and cereals for any purpose other than human food, with certain limited exceptions; secondly, the setting up of maximum prices, rather than fixed prices, for all agricultural commodities, such prices to be fixed in due relation to one another to ensure maximum production of indispensable products; and lastly, the rigid enforcement of such regulations by the infliction of penalties which none could afford to risk. Prof. Wood is to be congratulated on the clearest exposition of the food situation that has yet been submitted to the lay public, and the widest possible circulation of his views is eminently to be desired.

C. C.

UNIVERSITY REPRESENTATION IN PARLIAMENT.

THE provisions of the Franchise Bill as regards the representation of Universities are based on the recommendations of the Speaker's Conference on Electoral Reform, issued early in the present year, under which Oxford and Cambridge retain two members each, London is grouped with Durham, Manchester, Birmingham, Liverpool, Leeds, Sheffield, Bristol, and Wales to form a constituency returning three members, and the Scottish Universities are to form a single constituency returning three members. The degree is to be the basis for electoral qualification. In view of the attacks to which the University franchise has been subject in recent years, this full recognition of the principle of University representation will be gratifying to those who believe that it constitutes a valuable element in our electoral system. As Mr. Balfour said in the House of Commons in July, 1913, the representation of Universities is an honour paid by the country to the cause of higher education, which gives the power of getting into the House of Commons men of science, men of scholarship, men of special and peculiar gifts quite alien from the ordinary working politician. It is, both in theory and practice, a form of proportional representation, enabling men and women of special training and experience to form themselves into constituencies and to return to Parliament representatives qualified to promote higher education and the advancement of science and learning, aspects of our public life which are least likely to secure representation through the ordinary channels.

The recommendations of the Speaker's Conference, while extending the University franchise to the newer Universities, articulate well with the present system of University representation, save in one particular, viz. the proposal to deprive the University of London of the separate representation which it has enjoyed since 1867. NATURE is not concerned with party politics, but there can be no doubt that the reason for this proposal—though no explanation is offered in the report of the Conference—was to form a large University constituency (by grouping London with the newer Universities), which might confidently be expected to return one, or possibly two Liberal members. In the earlier years of its Parliamentary representation London returned three Liberal members—Robert Lowe, Sir John Lubbock, and Sir Michael Foster. At the present time, however, all the University members in Parliament are Conservative or Liberal Unionist, a state of things which is probably responsible for the proposed adjustment. It is most unfortunate, however, that for party reasons the University of London should be victimised by being deprived of its right of separate representation, and this at a time when thousands of its graduates on active service are unable to make their influence felt on the question. If the principle of grouping is sound, it should have been applied to Oxford and Cambridge, which not only retain separate representation, but are also to return two members each.

On the basis of the number of their graduates, neither Oxford nor Cambridge has a stronger claim for two members than London. To secure the representation of the smaller Universities some method of grouping is inevitable; but the result of joining London, with its roll of graduates many times longer than that of any of the other Universities of the group, will be to form an unwieldy and heterogeneous constituency, dominated by the London vote.

The *Times Educational Supplement* has suggested in a leading article that, "had the history of the University [of London] been less chequered, it may be that it would have retained separate representation." Those who know anything about the University of London will be disposed to think, on the contrary, that the University would be held in higher respect if its history had been *more* chequered, if it could show more of the scars of battle against ignorance and obscurantism. However that may be, the English system is to build on tradition, and to preserve principles and institutions which, as

Mr. Balfour has said, have "slowly grown up under the moulding influence of circumstances, acting from generation to generation"; and the surest way of disheartening a University, and "chequering" its future history, is to exacerbate the feelings of its graduates by depriving them of a cherished privilege.

The immediate question is whether some modification of the proposals of the Speaker's Conference is practicable which would not break down the compromise accepted by both political parties. Sir Philip Magnus, Sir William Collins, and Mr. M'Kinnon Wood (all of whom are London graduates), Sir James Yoxall, Mr. Fell, and Mr. George Faber, have put down an amendment to the Bill providing that the University of London shall return one member, and that the other Universities of the proposed group shall form a constituency returning three members. If accepted, this arrangement would mean an increase of one in the total number of University representatives, eleven instead of ten contemplated by the Speaker's Conference. It is expected that the amendment will be moved in the course of a few days. We hope the amendment will be adopted, thus repeating the history of fifty years ago, when a proposal to join London to another University to form a constituency was defeated against the Government, and London obtained the privilege of separate representation which it has since enjoyed.

T. LL. HUMBERSTONE.

THE EDUCATION BILL.

THE history of the measures for reform and improvement in the means and methods of education introduced into the House of Commons since the passing of the Education Act of 1902, which did so much for advanced education and to increase the public responsibility for all forms of education, has been one long tale of disaster; and Minister after Minister has succumbed to the opposition his measures have provoked.

It would seem, judging by the announcement made by Mr. Bonar Law in the House of Commons on October 19, that the same doleful fate awaits the Bill brought in by Mr. Fisher on August 13 last with such favourable omens. The personality of Mr. Fisher, his known deep interest in the subject, the sound knowledge and experience he has brought to bear upon it, together with the lucid and interesting exposition of the details of his measure, have won for it wide and favourable recognition and a strong body of support, due no doubt to those clauses of the Bill which have for their object the welfare of the child, whether in the condition of infancy or throughout the years of adolescence, so as to secure for the child the fullest opportunity of effective moral, intellectual, and physical training.

The advent and circumstances of the war have awakened amongst all classes of the people, employers and employed alike, a deeper sense of the value of education and of the responsibility of the nation for the adequate preparation of the children for the duties that await them. It has at last been brought home to those engaged in industry and commerce that Germany's position as a formidable rival is wholly due to the splendid facilities she has provided for the due training of her people, and that successful competition with her can be assured only by the adoption of a similar policy. Grave questions of reconstruction are under consideration, but they can be assured of their desired effect only in so far as they appeal to an educated people. The increasing industrial applications of scientific discovery demand a higher range of intelligence amongst all classes, and it is no less important for the well-being of the nation that the ampler leisure now urgently sought should be wisely used and enjoyed—a condition possible only where the means and opportunity of an efficient education exist. The ravages of the war, which has taken so huge a toll of educated young life, furnish another admittedly grave reason why we should at once make provision for the adequate education of all our youth.

Let it be remembered that Mr. Fisher was called from a position of high educational distinction in order that he might bring the ripe fruit of his knowledge and experience to bear upon the problem of ensuring the means of a more efficient education for the people of this country, and that it is little short of a cruel irony to refuse him the necessary time for the full consideration of his proposals. It is true that there are grave objections to some of the administrative clauses of the Bill, especially those which tend to increase the bureaucratic power of the Board of Education, but they are not of the essence of the measure, and may with advantage be taken out of the Bill. As to the threatened opposition of the textile industry, the only answer there can be is that the interests of the child are paramount. It should be possible to arrange upon an agreed measure, so far as the educational clauses are concerned, and so satisfy the ardent desire of the great majority of the people that such a measure should pass into law. There are strong reasons why further time should not be lost, since before the educational proposals embodied in the Bill can have their desired effect there is much to be done in the provision of teachers, equipment, and suitable buildings.

PROF. EDWARD HULL, F.R.S.

PROF. EDWARD HULL, who died in London on October 18, was born at Antrim, where his father was rector, on May 21, 1829, and had thus reached his eighty-ninth year. Like many of those whose work has lain in the open air, he retained considerable vigour, and he revisited at the age of eighty some of the scenes of his early observations. His father proposed for him a career in the Church of Ireland, and his early literary and biblical studies no doubt left an impression on his life. Attracted, however, by

experimental science, Hull entered Dublin University as a student of engineering, and the lectures of Thomas Oldham determined his career. Oldham recommended him to De la Beche, and he was appointed to the English Geological Survey as assistant to J. Beete Jukes.

These names serve to link Hull with the pioneers of British stratigraphy, and it was Murchison who nominated him in 1869 to succeed Jukes as director of the Geological Survey of Ireland. In his "Reminiscences of a Strenuous Life" (1910), reviewed in NATURE, vol. lxxxiii., p. 395, interesting details are given of scientific life in Dublin when he entered on his new duties. In the same year he became professor of geology in the Royal College of Science for Ireland.

The series of sheets of the one-inch geological map of Ireland, already well advanced by Jukes for the southern area, was pushed forward by Hull with such prevision that the first issue was completed by the date of his retirement in 1890. Some of the revisions made in Jukes's work may be regarded as unfortunate; but the northern sheets, with their admirable choice of colouring, remain as a monument to Hull's powers of organisation. He was probably the first to utilise the petrological microscope as an aid to research in an official survey ("Memoir to Sheet 48," Ireland, 1872), and thus laid the foundation for much memorable work.

Hull's first published paper was on the Cotswold Hills in 1855, and was succeeded by more than 150 others. Much of his time on the survey of England and of Scotland was spent on Carboniferous areas, and his book on "The Coalfields of Great Britain" reached a fifth edition in 1905. He was a member of the Royal Commissions on Coal Supplies in 1871 and 1901. As the result of a journey on behalf of the Palestine Exploration Fund, he published a narrative volume (1884) and a geological memoir on Palestine (1886). His "Physical Geology and Geography of Ireland" (1878; 2nd ed. 1891) and "The Building and Ornamental Stones of Great Britain, etc.," are well-known treatises. A good portrait of Hull occurs in the "Reminiscences" above mentioned.

NOTES.

THE late Mr. Cawthron left 250,000*l*. to the city of Nelson, New Zealand, for scientific research. The trustees are the Bishop of the diocese, the member for the district, the Mayor of Nelson, two chairmen of local bodies, and a personal friend of the deceased. The site of the proposed institute has been purchased, and the appointment of a director and staff is under consideration. The object of the institute is, primarily, scientific research work for the benefit of the province of Nelson and the Dominion of New Zealand. The province of Nelson is mostly concerned with fruit, agriculture, and minerals.

UNDER the title of "Science and Industry," the *Evening Standard* has recently published a series of five articles discussing the bearing of applied chemistry in its various branches on the welfare and safety of the nation. The national importance of chemical manufacture lies in the circumstance that so many undertakings included in this category are key industries, representing vulnerable points in the commercial armour of a nation. For instance, in a country deprived of its supply of sulphur, the manufacture of sulphuric acid would at once cease. This stoppage would react immediately on the production of alkalis, and these in turn would affect the output of soap and glycerine, which would not be obtainable. Without sulphuric acid, the manufacture of nitric acid from nitre could not be continued, and the production of explosives would be brought to a standstill. In this way whole sections of commercial activity would be completely dislocated, and the nation would be left practically defenceless. A similar line of reasoning shows that the manufacture of synthetic dyes is also a key industry. These chemical industries have all developed from researches often carried out, in the first instance, merely out of scientific curiosity. In fact, nearly all the more important and revolutionary advances in industrial chemistry have sprung from pure research, although utilitarian researches carried out on special lines have contributed minor improvements. The former type of research should be subsidised by the State, whereas the latter should be maintained by the manufacturers. Scientific men, who have shown undoubted aptitude for the all-important pure research, have often to pretend that their investigations have a quasi-industrial bent in order to justify their activities in the eyes of departmental donors. The writer of the articles in our contemporary asserts that in the difference between England and Germany as regards the development of science and industry "there is no question of superior intellect or greater technical skill or a more suitable national temperament," but he also blames the nation as a whole for the lack of progress in industry based on chemical science. Surely what is lacking in the nation is the inspiration of a lofty ideal. In actual practice honour and public esteem come to him who acquires most wealth, and the choice of a profession is regarded merely as a means to this end. As the German scientific industrialist, von Rathenau, has recently pointed out, this is not the sole end in view of the many hundreds of chemists and other investigators who discover and improve the scientific processes of manufacture which are the most valuable assets of the German chemical monopolies.

DR. OTTO KLOTZ has been appointed Chief Astronomer and Director of the Dominion Astronomical Observatory at Ottawa.

THE death is announced, on October 27, of Mr. Worthington G. Smith, of Dunstable, fellow of the Linnean and other societies, at eighty-two years of age.

WE notice with regret the announcement of the death on October 24, at fifty-four years of age, of Mr. George T. Holloway, vice-president of the Institution of Mining and Metallurgy, and widely known as a consultant metallurgist and assayer.

A COURSE of twelve Swiney lectures on geology will be delivered by Dr. J. S. Flett at the Royal Society of Arts on Tuesdays, Thursdays, and Fridays, beginning on Tuesday, November 13. The subject will be "The Mineral Resources of the British Empire." No charge for admission will be made.

WE notice with much regret the announcement that Baron Dairoku Kikuchi died suddenly at his villa at Chigasaki, Japan, on August 19. Baron Kikuchi was formerly professor of mathematics in the Imperial University at Tokyo, and afterwards its president. He was the author of many contributions to scientific

journals and several books, including a notable volume on "Japanese Education," consisting of a series of lectures delivered at the University of London in 1907.

AT the meeting of the Optical Society to be held on November 8 at the Imperial College of Science and Technology, South Kensington, Lt.-Col. A. C. Williams will describe certain optical stores which have been captured from the enemy. Among the instruments to be shown will be a one-man range-finder, director for field artillery, director for heavy artillery, dial sights, clinometer, sight clinometer, gun-sights or sighting arcs, stereoscopic telescopes, periscopes, Galilean binocular, and sighting telescopes for machine-guns.

PROF. E. S. REYNOLDS will deliver the Bradshaw lecture of the Royal College of Physicians of London on Thursday, November 8. The subject will be "The Causes of Disease." On the same day the Bradshaw lecture of the Royal College of Surgeons of England will be given by Sir John Bland-Sutton, who will take as his subject "Misplaced and Missing Organs." The FitzPatrick lectures of the Royal College of Physicians of London will be delivered on November 13–15 by Dr. A. Chaplin. The subject chosen is "Medicine in England during the Reign of George III."

DR. T. BRAILSFORD ROBERTSON, professor of biochemistry and pharmacology in the University of California, has executed a deed giving to the University of California all his patent rights in the growth-controlling substance, "Tethelin," isolated by him from the anterior lobe of the pituitary body, and employed to accelerate repair in slowly healing wounds. All profits from this discovery are to constitute an endowment, the income to be applied to medical research. It is felt by the University of California that one especial value of the establishment of this foundation is the example which it sets for a procedure by which other investigators may dedicate the results of their scientific discoveries to the benefit of mankind as a whole.

WE regret to announce the death of Sir W. J. Herschel, Bart., grandson of the famous discoverer of Uranus, and son of the no less distinguished Sir John Herschel. In 1823 Purkinje, the eminent physiologist of Breslau, had directed attention to the subject of finger impressions. There has been some controversy on the part taken by Sir William Herschel in utilising this discovery for the practical purpose of the identification of criminals, but the history of the subject is given by him in "The Origin of Finger-Printing," published last year (see NATURE, vol. xcviii., pp. 268, 388). In 1859 Sir William directed the attention of the Indian Government to the importance of the question. His advice was neglected, and it was not until 1897, nearly twenty years after he had left India, that the matter was investigated by a committee of experts, and Mr. (now Sir Edward) Henry, then Inspector of Police in Bengal, was associated with the introduction of the system into that province. Under him, as Commissioner of the London Police, the invention has been fully and scientifically applied to the investigation of crime. It is remarkable that Herschel was overlooked in the distribution of Indian honours. On his retirement from India he settled at Oxford, where he took a useful part in local affairs.

A CONFERENCE of representatives of provincial museums was held in the Town Hall, Sheffield, on October 16 and 17. Alderman W. H. Brittain, chairman of the Library and Museums Committee, presided. The first day was devoted to papers and discussions on the relation of museums to all grades of schools and education generally, an account being given of the work done in that direction by various museums, with practical suggestions as to its extension and more direct co-ordination. Mr. H. A. L. Fisher, who was unable to be present, expressed his interest in the conference, and arranged for four of the chief divisional inspectors for the Board of Education to attend, representing art, technical, elementary, and secondary schools. The exchange of views which took place should help towards a more vital connection between the museums and the schools. The second day was devoted to war museums, the proceedings being opened with a letter from Sir Whitworth Wallis on the subject, his absence being due to indisposition. Mr. Herbert Bolton read a paper outlining the purposes of war museums, and Mr. R. F. Martin, of the Victoria and Albert Museum, followed with a practicable scheme for their establishment in country villages. A full report was taken of the proceedings, and a committee, with Mr. E. Howarth as editor, was appointed to arrange for its publication *in extenso*.

ONE of the consequences of the increasing shortage of shipping, caused not only by actual losses due to submarine attacks, but also by still expanding war requirements which monopolise more and more of the depleted fleets of merchant shipping, has been to stimulate the production of pig-iron in this country from ore won in its own mines. The product of the smelting of this ore is known as basic pig-iron, because it requires to be treated by the basic, as contrasted with the acid, process for its conversion to steel. The Ministry of Munitions has been charged by the Government with the duty of increasing the supply of this iron, and has called upon various firms to co-operate. On one hand increased supplies of ore have been mined. On the other existing furnaces have been adapted to the new requirements and new blast-furnaces have been built. One of these was "blown in" on October 20 at the Stanton Ironworks, near Ilkeston, Derbyshire, and Mr. G. H. Roberts, M.P., Minister of Labour, was present at the ceremony. Before the war the nine furnaces of this company were engaged in making foundry pig-iron. To-day two of these have been diverted from this purpose and are making basic pig for steel sheets. To these must be added the new furnace which has been erected by the company. In this way the necessity of importing ores from abroad is being reduced in a highly satisfactory manner.

ANOTHER, the eighth, set of public lectures during the war has been arranged by the Chadwick trustees. The course began on October 29 at the Hampstead Central Library, when Dr. Charles Porter lectured on the prevention of the common infectious ailments. The programme also includes the following forthcoming lectures:—During the current quarter, at Gretna, Prof. H. J. Spooner on fatigue and the worker—causes, effects, and reliefs, and Sir John Stirling Maxwell, Bart., on forestry as an after-the-war employment. During November, Dr. Woods Hutchinson will lecture at the Robert Barnes Hall, Royal Society of Medicine, Cavendish Square, W.1, on the part of hygiene in the European war. At Leicester, in November and December, Mr. H. T. Davidge will lecture on electricity and national welfare. In February next Prof. Spooner will discourse at Huddersfield on the powers of man as a worker. On October 26 Prof. D. Noel Paton lectured at Gretna on food in war-time. He pointed out that a man doing an average day's work requires about 3000 Calories supplied in his food. The food as purchased must contain about 15 per cent. more than this because there is loss in distribution and cooking and in the process of digestion. Women and children at different ages require proportionately less energy and therefore less food.

The requirements of all groups constituting the population may be calculated, and it is found that the minimum requirement of the nation is something like $43\frac{3}{4}$ million million energy units per year. To find how far the food supply in pre-war time was adequate to yield this, statistics have been collected and the energy yielded by the food has been determined, and has been found sufficient to yield 51 million million energy units—about 15 per cent. above the calculated minimum requirement. Of this food more than half was imported. Further particulars of Chadwick lectures may be obtained from the secretary, offices of the Chadwick Trust, 40 (6th) Queen Anne's Chambers, Westminster.

IN *Man* for October Dr. W. L. Hildburgh describes an interesting example of disease transference witnessed by him at Benares. When an attack of disease is attributed to the malevolence of the spirit of a woman who has died in childbirth, known as *churel*, a little palanquin, a doll, and some other articles are placed at night at a spot where four roads meet. Dr. Hildburgh regards this device as a kind of trap to outwit the evil spirit, the idea being that anyone treading on these articles will carry the dangerous influence away with him. The cross-roads are naturally selected as the place at which such dangerous influences may be most readily dispersed.

SIR JAMES FRAZER has published, as an instalment of his forthcoming work on the folklore of the Old Testament, a paper read before the British Academy (Proceedings, vol. viii.) entitled "Jacob and the Mandrakes," in which he discusses, with an abundant quotation of examples, the belief that this plant (*Mandragora officinarum*) is regarded as a potent agent in magic, particularly as a means of promoting fertility. "Such beliefs and practices illustrate the primitive tendency to personify Nature, to view it as an assemblage of living, sensitive, and passionate beings rather than a system of impersonal forces. That tendency has played a great part in the evolution of religion, and even when it has been checked or suppressed by the general mass of educated society, it lingers still among the representatives of an earlier mode of thought, the peasant on one hand and the poet on the other."

THE potato tuber moth (*Phthorimaea operculella*)—a well-nigh cosmopolitan pest—forms the subject of Bulletin 427 of the U.S. Dept. of Agric., written by Mr. J. E. Graf. A special feature of this paper is seen in the attention paid to parasitic Hymenoptera and other insect enemies of the caterpillars.

A NEW species of Lima from the English chalk is described by Mr. T. Sheppard in the *Naturalist* for October. Differing very markedly in shape from any other of the Cretaceous Limidæ, the author proposes to name his specimen *Lima* (*Plagiostoma*) *middletonensis*. It most nearly resembles *Lima hoperi*, which has a wide range in the south of England, and is found in the same quarry as that from which the new species was obtained. The distribution of *L. middletonensis* is given as the "base of the *Micrastur coranguinem* zone, Middleton-on-the-Wolds, East Riding of Yorkshire."

A PAPER by Mr. A. Busck in the *Journal of Agricultural Research* (vol. ix., No. 10) on the pink bollworm (*Pectinophora gossypiella*)—a well-known cotton pest with a very wide range—is noteworthy for the extreme care devoted to structural details of the insect in its various stages, which are illustrated by exceptionally good drawings. These minute details are not without economic importance, as the scavenging caterpillar of *Pyroderces rileyi*, often found in open cotton bolls, is, at times, mistaken for the true "bollworm." The imago, larva, and pupa of Pyroderces are also most carefully described and figured for purposes of comparison.

COLEOPTERISTS will be glad to know that a fine specimen of the rare Curculionid beetle, *Tapinotus sellatus*, has been found in the Norfolk fens, since it is just seventy-one years ago that the last specimen was taken. This capture, announced in the *Entomologist's Magazine* for October, was made by Mr. O. E. Jason, who, in June last, made a very thorough search for this insect in the neighbourhood of Horning. It is to be noted that it was not found in association with its reputed food-plant, *Lysimachia vulgaris*. Only two other specimens of this beetle have been taken in Great Britain, the first at Horning in 1836, the second at Whittlesea Mere in 1846.

UNDER the title "Some Museums of Old London" Mr. W. H. Mullens, in the *Museums Journal* for October, gives a most interesting account of William Bullock's Museum. This was removed in 1809 from Liverpool to London, where it was housed, first at No. 22 Piccadilly, and three years later at the Egyptian Hall, Piccadilly, which was pulled down a few years ago. Mr. Mullens, however, does not confine his survey entirely to the museum, but brings together some interesting details of Bullock himself, including an account of his chase of the last living specimen of the great auk, which was later killed and placed in his museum, and now rests in the British Museum. In a later contribution the author promises to give a detailed description of the museum itself, its contents, and the story of its dispersal.

CONSIDERABLE interest was aroused during the summer months by somewhat sensational newspaper accounts of a plague of caterpillars of the "antler" moth (*Charaeas graminis*) in the north of England. Two short articles in the *Entomologist's Monthly Magazine* for August (vol. liii., No. 639), by Mr. G. T. Porritt and Dr. A. D. Imms, contain trustworthy information on the subject. From the latter we learn that "in point of numbers and area affected the present year has probably exceeded all previous records, at any rate so far as the United Kingdom is concerned." The larvæ swarmed in hill pastures from Cumberland to Cheshire and Derbyshire, feeding, however, only on "bent grass" (*Nardus stricta*), and not attacking either good meadow grass or corn crops.

AN exceptionally interesting contribution to our knowledge of the insects of the Carboniferous period is made by Mr. Herbert Bolton in a paper (Mem. Manchester Lit. and Phil. Soc., vol. lxi., part 1) on the "Mark Stirrup" collection of fossil insects from the Coal Measures of Commentry—that famous locality in central France whence came the 1300 specimens described in Ch. Brongniart's classical "Recherches" (1894). Most of the species now brought to light by Mr. Bolton are blattoids. Of special importance are two specimens made types of new genera, one of which—Megagnatha—is referred to the Perlidæ (stone-flies), with which it agrees in nervuration, though it differs in the possession of elongate and formidable mandibles, while the other—Sycopteron—is regarded as an ally of the Panorpidæ (scorpion-flies). To have established the existence of such a comparatively specialised type among the Palæozoic fauna is a noteworthy achievement. The illustrations are admirably reproduced from enlarged photographs. Another paper on Palæozoic insects has been published by Mr. H. Bolton in the Quart. Journ. Geol. Soc. (vol. lxxii., 1916, part 1); this contribution deals with insects from the British Coal Measures. Several wings and wing frag-

ments are described, most of them being referable to the well-known generalised group of the Palæodictyoptera.

THE sixth volume of the "Icones Plantarum Formosanarum," by Bunzō Hayata, has recently been published, and, like its predecessors, is a valuable contribution to our knowledge of the flora of the island. There are 168 pages of text, containing studies of 212 species, belonging to a large number of natural families, 126 of which are new to science. One genus, Parasitipomæa, is described for the first time, and there are nine genera recorded which hitherto have been unknown in Formosa. The new genus, belonging to the Convolvulaceæ, is interesting in having flowers like those of Ipomæa, but the plant is a leafless parasite. A large number of new orchids, sedges, and grasses are among the plants described and figured. Throughout the text there are numerous excellent figures, and the volume is further enriched by twenty well-drawn plates.

THE recently received report of the Ceylon Agricultural Department for 1916 gives indication of activity and sound work under the new director, Mr. F. A. Stockdale. A welcome sign of the new administration is the issue of practical leaflets, intended for the use of planters, on plant and insect pests and other agricultural matters. Three of these have recently been published. No. 3 deals with the beautiful fluted scale which attacks Acacia trees, and in California is a serious pest on Citrus. In Australia, whence the pest seems to have come, it is held in check by parasitic flies, etc. The leaflet is issued as a warning to prevent, if possible, the spread of the insect. The second leaflet is concerned with the black-rot disease of tea, a sterile fungus of the genus Hypochnus, which attacks the leaves, and may prove to be a serious menace to the tea industry of the island unless kept under control.

AN account of observations made during the past three or four years on the cause of the common dry-rot of the potato tuber in the British Isles is communicated by Dr. G. H. Pethybridge and Mr. H. A. Lafferty to the Scientific Proceedings of the Royal Dublin Society (vol. xv. (N.S.), No. 21, June, 1917). In confirmation of previous work, it is established that the dry-rot of the potato tuber which commonly occurs in the British Isles is due to the attacks of a parasitic species of Fusarium, which is now definitely identified, however, as *F. coeruleum* (Lib.), Sacc., rather than *F. Solani*, Sacc., as was previously believed. *F. coeruleum* does not produce hadromycosis of the potato plant, nor does it kill the plant by attacking the roots. It can destroy tomato fruits, but does not attack onions, mangels, carrots, parsnips, or apples. Infection takes place through wounds, but can also be effected through the lenticels, eyes, or young sprouts of uninjured tubers. Some varieties of potatoes are more resistant to infection than others. Potatoes become more susceptible to infection as they become more mature, hence the rot is more prevalent during the later than during the earlier period of storage. No effective preventive measure or cure has yet been devised.

SOME geological problems regarding the valley of the Isonzo form the subject of a paper by Prof. Torquato Taramelli in the *Rendiconti del R. Istituto Lombardo* (vol. xlix.). Our knowledge of the geological structure of this valley was first made known by D. Stur, of whose work Taramelli gives a brief abstract. About 1870, when on the staff of the Technical Institute at Udine, Taramelli published a paper on glacial action in the valleys of the Drava, the Sava, and the Isonzo, and this work was continued in 1874, in which year Lipold published a geological map of the Isonzo valley. At Idria are mines of cinnabar, discovered in 1490. More recently a new tunnel on the line to Tolmino has been the subject of a paper by Franz Kossma. The works of Brückner and Penck on this district are discussed in considerable detail, and the paper is illustrated by a map showing the course of the principal rivers and the peri-Adriatic fracture.

THE "Report on the Building and Ornamental Stones of Canada," vol. iv. (Manitoba, Saskatchewan, and Alberta), issued by the Canadian Department of Mines, contains characteristic and excellent coloured plates showing the texture of the principal rocks described. The modes of testing are stated, among them being a corrosion test, in which cubes of stone are suspended for four weeks in a vessel containing water into which carbonic acid gas and oxygen pass. The loss or gain in weight is calculated to the square inch of exposed surface, and in no case is a gain in weight recorded. Arrangements are made for securing that the pressure in the liquid remains uniform, since this factor largely affects the solution of limestone. It is important to note colour-changes resulting from this test; thus bluish sedimentary rocks may become distinctly yellow. The porosity test is conducted by filling the pores with water under a pressure of 2000 lb. to the square inch, continued for twenty-four hours. The limestones vary in pore-space from 0·292 up to 12·72 per cent., while one of the granites, which shows considerable fracturing in the field, has a porosity as high as 0·606.

A REPORT of the Liverpool Observatory at Bidston by the director, W. E. Plummer, published by the Mersey Docks and Harbour Board, gives detailed seismological and meteorological observations for the year 1916. In the course of the year 184 earthquakes were registered, and a table is given showing the time and amplitude of each. Tables are given of the total amount of sunshine and the maximum wind velocity recorded on a Dines anemometer for each day, and there are daily results of the barometer, temperature, rain amount and duration, velocity and pressure of wind, with the points of the compass from which the wind blew. The old units of measurement are still adhered to, although in the summary of results for the year the barometric measurements and the rainfall are given in inches and millimetres, and the air temperature in Fahrenheit and Centigrade. Thermometers are exposed in Stevenson's screens, both on the north and south sides of the observatory, and the comparison is said to show that the past records, made entirely on the south side, are too high, owing to radiation from the southern front. No failure occurred throughout the year in the firing of the gun as a time-signal for the shipping in the neighbourhood.

Symons's Meteorological Magazine for October shows the weather conditions for September to have varied considerably in different parts of the British Islands. The rainfall tables afford a fairly good representation, for so early a date, of the relative dryness of September in most parts of the country, although there was an excess of rain in places. In the English midlands the rainfall was mostly slight, and at Worksop, Nottinghamshire, the total measurement was only 31 per cent. of the average. At Borrowdale, Cumberland, the rainfall was 18·04 in., which is 6·76 in. more than the average. In parts of Cumberland and Westmorland the September rains are said to be as much as 20–25 in. in places. For England and Wales the rainfall for the month is given as 88 per cent. of the average, Scotland 95 per cent., and Ireland 77 per cent. The mean temperature was above the average in most parts of the United Kingdom, and there was generally

a deficiency of sunshine. An examination of the details given in the issues for the last six months shows that for the whole summer from April to September inclusive the rainfall for England and Wales was 109 per cent. of the average, in Scotland 91 per cent., in Ireland 106 per cent., and for the British Islands as a whole 104 per cent. The wettest month was August over the entire kingdom, and the driest July in Great Britain, whilst September was the driest in Ireland. In London, according to the observations at Camden Square, the rainfall for the six months was 19·90 in., 144 per cent. of the average, and every month was wet except April.

THE September number of *Terrestrial Magnetism and Atmospheric Electricity* contains the preliminary report of the magnetic survey work of the *Carnegie* during her four months' voyage from San Francisco to Easter Island and Buenos Aires last winter. Throughout the whole region traversed the compass deviates to the east of north by amounts between 3° and 30°. The errors of the British Admiralty chart at points on the course—almost directly south—from San Francisco to Easter Island, rarely exceed half a degree, the deviations given in the chart being in excess in the northern and in defect in the southern portion. From Easter Island round Cape Horn to Buenos Aires the errors of the Admiralty chart are on the average greater, but for the region near Cape Horn itself the chart is practically correct. In general over this part of the ocean the deviations given are smaller than those found by the *Carnegie*.

IN view of the public interest in the Mesopotamian Report, an article in *Engineering* for October 19 calls for special notice. This article gives a complete account, with many illustrations from photographs, of the new hospital ships for the Mesopotamian Expedition. These ships have been designed by Sir J. H. Biles and Co., who have embodied in the plans the requirements which the experience and foresight of Brevet Lt.-Col. Marham Carter have shown to be essential. The vessels are 160 ft. in length and 30 ft. in breadth, and the draught is limited to 3 ft. 6 in. The hospital accommodation is arranged on three decks, covered by a sun deck. The flying deck, immediately beneath the sun deck, is used exclusively for convalescents, and the upper and main decks for more serious cases. The vessels are driven by oil engines, but a steam boiler is fitted and is available for heating purposes during the cold Mesopotamian winter. Ventilation and cooling arrangements of very complete character have been provided. A carbon dioxide refrigerating machine of capacity 5 cwt. of ice per day is fitted; also a soda-water machine capable of turning out three gross of soda-water, lemonade, or ginger beer per day. It is impossible in a brief note adequately to deal with the arrangements of the hospital wards, cots, operating-room, infectious cases ward, bathrooms, etc. Those interested should refer to the article in our contemporary. Lt.-Col. Carter is to be congratulated upon the completeness of the arrangements which have resulted from his courage and pertinacity.

AMONG forthcoming books of science we notice the following:—"Telegraph Practice," J. Lee; "A Text-book of Laying Off, or the Geometry of Shipbuilding," E. L. Attwood and J. C. G. Cooper (*Longmans and Co.*); "The Resistance of Air," Col. R. de Villamil; "Aluminium: Production and Use," J. T. Pattison (*E. and F. N. Spon, Ltd.*); "The Nature of Solution," Prof. H. C. Jones, with a sketch of the author's career by Prof. E. Emmet-Reid (*Constable and Co., Ltd.*); "Ship Stability and Trim," P. A. Hillhouse (*The Grieves Publishing Co.*); "Strength of Ships," J. B. Thomas (*Scott, Greenwood and Co.*).

THE Cambridge University Press has in preparation for appearance in the "Cambridge Farm Institute" Series:—"Plant Life in Farm and Garden," Prof. R. H. Biffen, and "The Feeding of Farm Animals," Prof. T. B. Wood.

OUR ASTRONOMICAL COLUMN.

THE PLANETS IN NOVEMBER.—During the present month Venus will be a conspicuous object low down in the south-western sky for a short time after sunset, Jupiter may be observed practically throughout the night, while Mars and Saturn come into view during later hours. Particulars as to their rising, southing, and setting, together with their stellar magnitudes, at the beginning and end of the month, are given in the following table:—

		Rises	Souths	Sets	Stellar mag.
Venus	Nov. 1,		2.51 P.M.	6 24 P.M.	−3·8
	,, 30,		3.15 ,,	7. 4 ,,	−4·0
Mars	Nov. 1,	0.15 A.M.	7.28 A.M.		+1·4
	,, 30,	11.45 P.M.	6.31 ,,		+1·1
Jupiter	Nov. 1,	5.56 P.M.	1.55 A.M.	9.54 A.M.	−2·3
	,, 30,	3.46 ,,	11.41 P.M.	7.36 ,,	−2·4
Saturn	Nov. 1,	10.51 P.M.	6.27 A.M.		
	,, 30,	9. 0 ,,	4.35 ,,		

Venus will be at greatest easterly elongation of 47° on November 30, when half the disc will be illuminated. Mars is near α Leonis (Regulus) on November 1, and afterwards moves eastwards towards Virgo.

Jupiter will be in opposition on November 29; on the 1st the planet will be 4½° north of Aldebaran, and will have a retrograde motion of nearly 4° during the month.

Saturn is in the eastern part of Cancer, and will be at a stationary point on November 26.

NEW ZEALAND STANDARD TIME.—The present arrangement whereby the standard civil time in New Zealand differs from Greenwich Mean Time by 11h. 30m. was adopted on the suggestion of Sir James Hector in 1868, before the general system of zone time was introduced. The council of the Wellington Philosophical Society has recently taken the matter into consideration, and has resolved to urge upon the Government the desirability of making New Zealand time exactly twelve hours in advance of Greenwich. New Zealand is so happily situated that it would be possible by this simple alteration to secure the advantages of a time system moderately in advance of solar time, and to bring the time into conformity with the international arrangement. As there is no extreme variation in the length of the day at different seasons it is proposed to put the clock forward by half an hour, once for all.

NEW STARS IN SPIRAL NEBULÆ.—Two new stars have been found in the spiral nebula N.G.C. 4321 by Dr. H. D. Curtis, of the Lick Observatory (Journ. R.A.S., Canada, vol. xi., p. 311). The first appeared at some time prior to March 17, 1901, and was then of about magnitude 13·5; it was a magnitude fainter in April, and has now completely disappeared. It was 110″ west, and 4″ north, of the nucleus. The second nova appeared at some time before March 2, 1914, and was then about magnitude 14; it was 24″ east, and 111″ south, of the nucleus. The position of the nebula for 1900 is R.A. 12h. 17·9m., declination +16° 23′.

Mr. Adams reports that Ritchey's nova in N.G.C. 6946 was rapidly growing fainter at the end of July; the colour-index shows that the star cannot be a long-period variable.

THE UTILISATION OF CONDEMNED ARMY BOOTS.

THE London Section of the Society of Chemical Industry has recently established what for lack of a better term we must call a club—that is, a society of its members and their friends, who seek to combine a chastened conviviality with an interest in technical chemistry. At a meeting of the club, held on May 21, Mr. M. C. Lamb, by permission of the Director of Army Contracts, brought to the knowledge of the members the various methods that have been suggested in order to utilise the leather in condemned Army boots, and which, in the absence of proper organisation, might lead, when we have regard to the present magnitude of our Army, to an enormous waste of material of considerable intrinsic value, even after it has served its primary purpose as footwear.

Mr. Lamb's paper appears in the issue of the Journal of the society for September 29, and as it affords a good illustration of what may be accomplished by the intelligent co-operation of experts and officials in dealing with a problem of special importance at the present time, a short summary of its contents may be of general interest. War is so terribly wasteful that any efforts to minimise its effects, even if they are only concerned with discarded boots, merit attention and appreciation.

It is not to be supposed that this particular problem has only just arisen. Even in peace-time the worn-out boots of "a contemptible little Army" had to be condemned. They were sold to contractors, who doubtless found means to turn them to more or less profitable account. But with millions of men under arms and in active service, the whole matter had to be dealt with in a very different fashion from that in pre-war periods, and the object of Mr. Lamb's communication was to show the results which have followed from attempts to discover means for the better utilisation of discarded footwear.

It will doubtless surprise many people to learn that waste boot leather has been found to be a good material for road-making, the scrap leather, preferably of soles (since a more profitable use can be found for the uppers), being mixed to the extent of from 5 to 10 per cent., depending upon the character of the road, with slag, granite, or limestone, in conjunction with asphalt and bitumen. It is claimed for this mixed material, which is known as "Broughite," from the name of the patentee, that it possesses the hardness and rigidity of the ordinary tar macadam road, with reduced attrition and dust and greater resilience. The method employed is to mix the scrap leather with the asphalt, bitumen, limestone, etc., lay the surface of the road with the composition, and give a top facing of slag, granite, or limestone. One ton of the tarred material is needed to cover six square yards with an application 4 in. thick, or some 89,000 pairs of discarded boots to each mile of a roadway eight yards wide. It seems a just and fitting retribution—a sort of poetical justice—that boots in their old age should be condemned to make good the roads they have trodden and worn down.

Experience has shown that "Broughite" is a cheap and satisfactory substitute for wood-paving; it possesses greater wearing qualities, and is equally silent; it costs much less than wood and no more than bituminous macadam. It affords a good grip for rubber tyres and an excellent foothold for horses. The Roads Board is making trials of its value, and several pieces of roadway have been laid down under its direction.

Waste leather makes an admirable form of *animal charcoal*. When subjected to destructive distillation leather yields about a fourth of its weight of a comparatively pure charcoal, which has a decolorising power, as tested on sugar syrups and gelatin, in nowise inferior to bone-char. At the same time, the distillation products afford from 23 to 25 per cent. of crude *ammonium sulphate*, suitable as a fertiliser.

The leather of boot uppers contains on an average about 15 per cent. of extractable *grease and fatty matter*, melting at about 38° C., and quite suitable for currying leather, and for other purposes in which a moderately hard low-grade grease suffices. The approximate present value of these products to be obtained from a ton, or 560 pairs, of condemned boots is rather more than 16*l*. 11*s*., of which the charcoal and ammonium sulphate are by far the more important items.

On account of its nitrogen content leather waste is regarded as possessing considerable potential value as a manure. It, however, decomposes very slowly, and requires special treatment to make it effective. Chrome-tanned material is found to be hurtful to plant-life.

Other uses for condemned military boots are in the manufacture of leather board, leather pulp and powder, clogs, washers for screw-down water-taps, mats, cyanides and prussiates, glue and size.

Evidently, as the time-honoured adage says, "there is nothing like leather," even from old boots.

THE ORGANISATION OF ENGINEERING TRAINING.

A CONFERENCE on the above subject was held at the Institution of Civil Engineers on October 25, delegates representing the chief engineering institutions and educational bodies, various Government departments, and a number of universities and technical colleges being present. Sir Maurice Fitzmaurice, president of the Institution of Civil Engineers, took the chair.

Sir Maurice Fitzmaurice, in opening the proceedings, remarked that there was a great gap between the period when a boy decided to become an engineer and when he actually entered on his training. There was general recognition that youths entering the engineering industry should receive uniformly sound training, and the proposals to be brought before the meeting related to the establishment of a central representative committee to secure better co-ordination in this matter. The council of the Institution of Civil Engineers felt that nothing but good could come of this meeting, in which all interests, educational, professional, and manufacturing, were represented.

A letter was read from Mr. H. A. L. Fisher, the President of the Board of Education, regretting his unavoidable absence from the meeting, and stating that the Board of Education would be glad to co-operate in any well-considered scheme which the engineering industry might adopt.

Mr. A. E. Berriman, one of the honorary organisers of the meeting, then gave a brief account of the origin of the movement, which was also the subject of a memorandum placed in the hands of those present. The proposal to form a central organisation for improvement in and better co-ordination of engineering training originated at an informal conference of engineers and educationists, which held several meetings at the Board of Education during the early months of 1917. It was considered desirable that in its initial stages the proposed organisation should be free from the need of Government finance, while co-operating with the Board of Education and other educational bodies. Mr. Fisher had concurred in this view. The chief objects of the organisation would include:—(1) Co-ordination in engineering training, the fostering of apprenticeship as a national institution, and promo-

tion of a wider appreciation of the value in industry of education of university rank; (2) the maintenance of a central bureau where parents and educationists can obtain accurate and comprehensive information relating to the industry, and the proper course to be pursued by boys entering it; and (3) the promotion of scholarships and other means by which the best talent may receive adequate educational opportunity.

In the ensuing discussion general approval of the proposals was expressed.

Among those who took part were Sir Dugald Clerk, Mr. Michael Longbridge (president of the Institution of Mechanical Engineers), Mr. C. H. Wordingham (president of the Institution of Electrical Engineers), Mr. W. H. Ellis (the Master Cutler), Mr. H. B. Rowell (president of the North-East Coast Institution of Engineers and Shipbuilders), Mr. R. T. Nugent (Federation of British Industries), Prof. W. E. Dalby, Lieut.-Commander C. F. Jenkin (Oxford University), Sir A. Selby Bigge (Board of Education), and Sir Wilfred Stokes (British Engineers' Association).

Finally, the following resolution was proposed by Sir John Wolfe-Barry, seconded by Dr. W. H. Hadow (principal of Armstrong College, Newcastle-upon-Tyne), supported by Mr. Arthur Dyke Acland, and carried unanimously:—"That this meeting of engineers and educationists is of the opinion that a need exists for improvement in and better co-ordination of engineering training, and considers that some form of central organisation is a desirable means to this end. It is therefore resolved that a representative committee, with powers to add to its numbers, be appointed to initiate means that will give effect to this principle of a central organisation." The first members of this committee are to be representative of twenty-six institutions and other bodies named.

Pending further developments, communications should be sent to Mr. A. Berriman (chief engineer, Daimler Co., Ltd., Coventry) or Mr. A. P. M. Fleming (British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park, Manchester), who were appointed to act as hon. organisers of the meeting.

THE OFFSPRING OF DEAF PARENTS.

WE have received from Dr. Alexander Graham Bell an interesting publication by the Volta Bureau, Washington, entitled "Graphical Studies of Marriages of the Deaf." Under Dr. Bell's direction, Mr. A. W. Clime has prepared about a hundred pages of graphical index to the marriages reported in Dr. E. A. Fay's well-known work on "Marriages of the Deaf in America," and likewise 301 pedigree charts of the marriages of the deaf that resulted in deaf offspring. Mr. F. De Land contributes two pages of introduction, which might have been expanded to great advantage. From Fay's 4471 marriages Dr. Bell has eliminated 974 in regard to which there was no information as to offspring, 419 where the marriage had taken place within a year of the date of report to Dr. Fay, and 434 that were childless when reported. The removal of these 1827 marriages left 2644 marriages of a year's standing or more, and with children.

The number of children recorded was 6782, of which 588, or 8·66 per cent., were deaf. These 588 deaf children were the offspring of only 302 of the marriages. After deducting two marriages (which resulted in three deaf children and "several" hearing children) because the total number of children born was not stated, Dr. Bell was left with 300 marriages the offspring of which were in varying proportions affected by deafness. The total number of children born was 1044; the number of deaf children among these was 585. The proportion of deaf is thus more than half, 56 per cent.

Another result worthy of note is that of the 2642 marriages considered the average number of children per marriage in the 300 marriages that resulted in deaf offspring was 3·48, while an average of only 2·44 per marriage was reported in the 2342 marriages resulting in no reported deaf offspring.

It may be recalled that in 1883 Dr. Bell presented a memoir to the National Academy of Sciences entitled "Upon the Formation of a Deaf Variety of the Human Race." His recent graphical studies clearly show that although the total percentage of families with deaf children, out of 2642 marriages where deafness marked one or both parents, was not extremely high, being about 12 per cent., the proportion of affected members of the 300 families with deaf offspring was very high, about 56 per cent.

That all the children of two deaf parents are not deaf is probably because the two parents are deaf in different ways, but Dr. Bell has in this publication refrained from any interpretations. In looking over individual cases, one is struck to see some where there was deafness in the husband and wife and in the relatives of both, but none in the children; other cases where there was deafness on both sides of the house, but only in half of the offspring; others in which there was deafness in one parent and none in the offspring; and others again in which the defect was in one parent only, but in all the offspring, or, say, in six out of seven.

One would have liked some discussion of the very interesting variety of results, which must surely mean that even after we have set aside deafness due to otosclerosis and to catarrhal weakness, the kind of deafness called deaf-mutism is not a homogeneous physiological condition. But some discussion would have been very welcome. As one looks over the charts one is struck by the rarity of the symbol which stands for "partially deaf," and the suspicion arises that it has not been sufficiently differentiated in the printing from the symbol for "deaf."

There is much obscurity in regard to the inheritance of deafness, and Dr. Bell's painstaking presentation of different family histories will enable experts to study individual cases. It must be impossible in many cases recorded to get medical opinion as to the nature of the deafness, but in the present-day accumulation of more data like Fay's an endeavour should be made to sift out varieties of deafness more radically than is involved in merely distinguishing between adventitious and congenital.

THE UTILITY OF THE USELESS.[1]

FOR several reasons it is a profitable exercise to trace back a modern invention, or commercial appliance, to the fundamental discoveries from which it sprang. In the first place, the debt of commerce to pure science is thus demonstrated; for it is safe to say that none of the numerous inventions and devices which are of such immense commercial importance at the present day could have come into existence had it not been preceded by one, or possibly many discoveries arising out of research pursued in a purely academic spirit. But, as being of far more importance from the point of view of the ardent beginner in scientific research, the tracing of the germinal discoveries upon which an invention is based is of value as showing how all academic research, remote though it may appear from the service of mankind, may contain

[1] Presidential address delivered to the Royal Physical Society, Edinburgh, by Dr. O. Charnock Bradley. Reprinted from the Proceedings of the Society for March, 1917.

within it the germ from which is to develop an influence capable of tincturing the whole fabric of a nation's existence. A moving pebble may start an avalanche. . . .

Moreover, the history of scientific discoveries serves to remind us of those complex factors underlying our daily life and the research, remote or recent, from which they have originated. The detailed processes of every day are so familiar that few spare the time to remember that upon scientific discovery depend all the contrivances and appliances which make modern life what it is. Indeed, one is tempted to pen the paradox that it is of the most familiar we have least knowledge. In contemplating the lordly oak, or in enjoying its shade, we forget its origin; and, assuredly, the timber merchant wastes no thought on the acorn.

An interesting chapter in the history of science could be written on the opposition against which discoveries of fundamental importance and ultimate great commercial value have had to fight for general approval and acceptance. Galileo's telescope, the Darwinian hypothesis, the clinical thermometer, anæsthetics, and a host of other revolutionising introductions have been opposed with a greater or less degree of acerbity. In the light of its modern development, it is scarcely conceivable that the electric telegraph was neglected for years until its possibilities were foreshadowed in a dramatic fashion in connection with the arrest of a murderer. On the introduction of the electric telegraph the "practical man" would have none of it, and yet in the short space of about half a century the telegraph, and its young relative the telephone, have completely revolutionised everyday commercial and national life. However great their value may be in times of peace, in time of war it is infinitely greater. Regard for a moment the influence exerted by the wireless form of telegraphy on

> This precious stone set in the silver sea,
> Which serves it in the office of a wall,

and something of the power of applied science, the offspring of pure science, becomes apparent. No text could better serve for a thesis on the small and neglected scientific beginnings of great things.

Search for the reason for resistance to new ideas and new speculations is not without interest to the biologist and sociologist. The first reason which suggests itself is that matter-of-fact, rule-of-thumb people are always in the majority, and, therefore, anything out of the ordinary is bound to meet with opposition in excess of approval. Or we might agree with George Eliot in saying that the practical mind and the narrow imagination go together, and with H. G. Wells in asserting that few have been accustomed to respond to the call of a creative imagination. There are few—and these not men of action—who are capable of looking forward into the future. We might also point to the fact that the pursuit of knowledge does not follow a straight line. It zigzags hither and thither, frequently halts, and indeed often has to hark back. Such erratic progress cannot make a very urgent appeal to the practical mind.

But these explanations are probably not entirely just to that necessary member of the community, the "practical man." It must always be remembered that only those of the future shall see the present—see it steadily and see it whole. The ultimate goal of a scientific discovery is hidden from those who were present at its birth. Moreover, a truth new-wrested from Nature seldom carries with it an indication of future possibilities. In most cases, and especially if it is a germinal truth, it possesses few attractive features to the eye of him who seeks for signs of future utility. "Truth new-born looks a mis-shapen and untimely birth."

In all probability what the sociologist has come to call the "herd instinct" is an important factor in producing resistance to the reception of the new and unusual. The "herd instinct" may be briefly explained as follows:—Man being a gregarious animal and leading the communal life, it is essential that his actions should be co-operative. The homogeneity necessary for co-operative action results from an inherent impulse on the part of each individual to think and act in conformity with the thought and action of his fellows. There seems good reason for concluding that homogeneity is the result of natural selection. There appears to have been an accumulation of experiences which, unconsciously so far as the individual is concerned, have demonstrated the necessity for following custom if the safety of the community, or herd, is to be ensured.

Admitting the operation of the "herd instinct," it is not difficult to appreciate the reason of that opposition to innovation which is so well and so frequently illustrated in the history of scientific discovery. For our present purpose, however, it is not so much necessary to explain the cause of opposition as to recognise its reality. Realisation of its occurrence and effect in the past renders more easily borne its encounter in the present.

No department of science contains more mysteries for the layman than does electricity. And no department of physical science contains more striking examples of pure academic research paving the way for the introduction of enormously important instruments of applied science.

The discovery of the deflection of a magnet by the passage of an electric current along a wire in its vicinity—a discovery which, as Faraday expressed it, "burst open the gates of a domain in science, dark till now, and filled it with a flood of light"—could not have been made had not Volta devised the means whereby a constant and steady current could be produced. Nor, without the same means, could François Arago have discovered that a bar of iron becomes a magnet when surrounded by a coil of wire through which an electric current is flowing.

If Volta's investigations made possible research capable of revealing the industrial applicability of electricity, it may be claimed that Volta, in his turn, was indebted to the old frictional machine for a basis upon which to found his inquiries. Tracing the chain of research still farther back, all the earlier discoveries depended upon an observation made by William Gilbert, of Colchester, one of the lesser sons of the Renaissance. If it is true to say that none of these inquiries was made in the utilitarian spirit, it is equally true to assert that Faraday's discovery of electro-magnetic induction was the product of research undertaken from purely academic motives. When Faraday's sacrifices to science are remembered, it is not difficult to realise that his work was not stimulated by a desire for personal profit. That mankind in general has profited, and that the wealth of nations has been augmented, are abundantly evident.

When Sir Anthony Carlisle and Mr. Nicholson made their extemporised Voltaic pile, and observed the decomposition of water by the current produced, they could not possibly have foreseen that by their speculative laboratory experiments they were laying the foundation of those enormous commercial industries which depend upon electrolysis. Much less is it conceivable that an enthusiastic youth of eighteen, endeavouring to make artificial quinine by the oxidation of aniline, could have foreseen that his accidental discovery would lead to the utilisation of what was formerly a wholly disagreeable nuisance in the shape of coal-tar, and thereby form the germ of the now more than ever famous aniline dyes industry.

Fascinating though it is to follow the fortunes of small discoveries in the physical sciences and see how they ultimately develop into great instruments of human service, it is, if anything, even more fascinating to trace the history of small discoveries in the biological sciences. And this is so, no doubt, because the contact of biology with daily existence is not so obvious and self-assertive as is that of physics or chemistry; consequently the ramifications of influence of biological research are more subtle, but none the less real.

Modern medicine—using the term to include surgery —it is safe to say, is that phase of biological science which has the most obvious effect upon daily human existence. Examined closely, it is clear that modern medicine is based upon a multiplicity of scientific discoveries; some of them of outstanding magnitude, many of them of minor consequence.

Fed upon descriptions of marvellous operations served up by a sensational Press, the layman is not slow to admit the wonders of modern surgery. Wonderful though the surgical stories of the lay Press may be, they are not really more marvellous than many of those stated in the cool, calculated, and technical language of the medical and surgical periodicals. Regard for a moment an operation recently described by an Army surgeon. "Somewhere in France" a soldier was shot. The bullet was located in the cavity of the left ventricle of the heart, and removed therefrom by operation. This feat was rendered possible by a long series of discoveries leading away back into regions far from the utilitarian. The determination of the position of the bullet depended upon the studies of Sir William Crookes on high vacua—a thing of yesterday—combined with the discovery of cathode-rays about two hundred years ago. The operation was rendered free from danger of sepsis by the development of the "germ theory"—now so familiar that we have almost forgotten that it originally bore this name—which reposed upon a long line of arduous research, including Pasteur's inquiries into fermentation, and, still more remotely, the peculiarities of tartrate crystals. These and many more academic inquiries placed the surgeon in possession of the means to perform an operation which, not many years ago, would have been regarded as daring in the extreme.

Frankly, this particular operation was chosen as an example of the triumphs of modern surgery because it was both sensational and topical. But equally wonderful work is done daily and far distant from the grim romance of the battlefield.

Instances of the application of scientific discovery to everyday problems and everyday needs might be multiplied almost without limit. But the foregoing must suffice to justify the contention that the fruits of academic research are not difficult to find in the appliances and contrivances which make the day's work what it is, and that the commercial wealth and prosperity of the world are in no small measure dependent upon discoveries of seemingly small and trifling moment, and nearly always of little utilitarian complexion. He who wishes to demonstrate to the man of commerce that it is in his own interest to encourage and aid the man of science need experience no difficulty in adducing facts in support of his argument. It is easily possible to prove the benefits that accrue to commercial undertakings out of the employment of a scientific staff. The proof is perhaps not so necessary now as it was not many years ago; but the necessity still exists, though in a modified degree.

But, while science is of service to commerce, the complete subjection of science to commerce or the requirements of the State would not be productive of entirely good results. The bending of research to purely utilitarian ends would be fraught with grave danger in several directions, and not least in that it would discourage investigations instigated by a thirst for knowledge for its own sake—investigations which history has shown may develop into discoveries of surpassing moment.

After all, the business of the man of science is to discover truth regardless of possible monetary profit either to himself or to humanity at large. Let the inventor use the knowledge if he cares and can. "Your business, your especial business," said Pasteur once to his students, "must be to have nothing in common with those narrow minds which despise everything in science which has no immediate application." And Pasteur, apart from the inestimable work he did leading to modern surgery, taught the vinegar-makers of Orleans how to increase their output, instructed France how to prevent the souring of her wines, and helped the brewers of London by instructing them concerning the importance of the purity of their yeast.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. J. E. Marr, University lecturer in geology, has been elected to the Woodwardian professorship of geology in succession to the late Prof. McKenny Hughes.

EDINBURGH.—The Lord Rectorship of the University, vacant since Lord Kitchener met his tragic fate, falls to be filled up next month. As on the last occasion, the students have determined to have no contested election, but have invited Sir David Beatty, Admiral of the Fleet, to be their Lord Rector. The invitation was forwarded by Mr. J. A. Stirling, president, and Miss Helen I. Walker, secretary, of the Students' Representative Council, and Admiral Beatty replied in these words:—"I should be proud to become the Lord Rector of Edinburgh University, and greatly appreciate the honour which the students of the University confer on me in offering to elect me to that high office."

LONDON.—The cordial thanks of the Senate have been voted to the London County Council for the grant of 600*l*. a year for the salary of the holder of the professorship of Russian to be instituted for tenure at King's College, and to the Worshipful Company of Drapers for the renewal for a further year of the annual grant of 500*l*. for the biometric laboratory at University College.

The following doctorates have been conferred:—*D.Sc. in Chemistry:* Mr. Nilratan Dhar, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "Catalysis: Some Induced Reactions and Temperature Coefficients of Catalysed Reactions." *D.Sc. in Psychology:* Mr. Shepherd Dawson, an external student, for a thesis entitled "The Experimental Study of Binocular Colour Mixture."

SHEFFIELD.—On October 25 General Smuts and Sir John Jellicoe visited the applied science department of the University to inspect work being carried on there in connection with the Ministry of Munitions. The distinguished visitors and party inspected the physical and metallurgical laboratories and alloys foundries, where many objects of interest were shown. The visit also included inspection of the shell shops and gauge and tool-room department. After inspection of the buildings, a conference was held with members of the Sheffield Committee on Munitions of War and other gentlemen.

THE Maria Mitchell Memorial Fellowship at Harvard Observatory, value 100*l*., is offered to a woman for the year beginning September 15, 1918. A competitive

examination will not be held, but the candidate must present evidence of previous educational opportunities and training, and give plans for future work, as well as examples of work already accomplished. Applications for the year beginning September 15, 1918, have to be in the hands of the secretary of the committee, Mrs. Charles S. Hinchman, 3635 Chestnut Street, Philadelphia, Pennsylvania, on or before April 1, 1918.

IN reply to questions asked in the House of Commons on October 29, the Chancellor of the Exchequer said that the Government recognised the urgency of the Education Bill, but the grounds on which he believed it was impossible to proceed with the Bill were substantial—want of time. He had discussed with the Minister of Education the possibility of dealing with the non-controversial clauses of the Bill this session. He thought the Minister of Education agreed with him that if the Bill could not be got through this session, it was not worth while to attempt to deal with part of it.—It will be remembered that in making his statement on the Education Bill in the House of Commons on August 10, Mr. Fisher said it was proposed:—(1) To improve the administrative organisation of education; (2) to secure for every boy and girl in this country an elementary-school life up to the age of fourteen unimpeded by the competing claims of industry; (3) to establish part-time day continuation schools which every young person in the country shall be compelled to attend unless he or she is undergoing some suitable form of alternative instruction; (4) to develop the higher forms of elementary education and improve the physical condition of the children and young persons under instruction; (5) to consolidate the elementary-school grants; (6) to make an effective survey of the whole educational provision in the country and to bring private educational institutions into closer and more convenient relations to the national system. These proposals have been welcomed by all who believe in education as a national asset of supreme importance. At its meeting on October 24, the Education Committee of the London County Council recommended:—"That the council do express generally its strong approval of the main educational provisions of the Bill, introduced into Parliament by the President of the Board of Education on August 10, 1917, which, in the opinion of the council, constitute an educational reform of great magnitude and value, not only for London, but for the rest of the country." The Essex Education Committee has also resolved to urge the Government to pass a measure on the lines of the new Education Bill at the earliest possible moment. It was stated at the meeting of the committee that a great feeling of dismay was experienced all over the country at the news that the passage of the Bill would be delayed.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, October 17.—Mr. Heron-Allen, president, in the chair.—H. **Sidebottom**: Recent Foraminifera dredged by H.M.S. *Dart* off the east coast of Australia in 465 fathoms. The locality lies off the coast of New South Wales, about 250 miles north of Sydney, and more than fifty miles from the coast-line. In this area the coast slopes rapidly down to Thomson Basin, an isolated deep (maximum 3000 fathoms) area between 24° and 52° S. and 149° and 165° E. Pteropods are found only in tropical and subtropical areas, and are of extremely limited occurrence in the Pacific. A great number of specimens are recorded, but few of more than local interest, the principal feature being a great variety of certain modifications of the genus Discorbina.—F. M. **Duncan**: Mounting and preserving marine biological specimens. The author described the methods adopted and standardised by him for the microscopical investigation of marine Algæ, Protozoa, general Plankton, Hydromedusæ, Echinodermata, larval and adult Crustaceans, Ascidians, etc. The importance of standard percentage solutions of formaldehyde, value of menthol as a general narcotic, advantages of turpineol as a clearing media for Crustacea, and the disadvantages of fixing with chromic acid or bichromic salts were also fully discussed.

PARIS.

Academy of Sciences, October 15.—M. Camille Jordan in the chair.—A. **Lacroix**: The leucitic lavas of the Somma. A comparison of six complete analyses of these Vesuvian leucitic rocks leads the author to classify them under the name of vesuvites. Their characteristic is their richness in leucite and in the value of the ratio of the alkalis to the felspathic lime. The leucitic rocks of the Somma are of a different type; nine complete analyses of the latter are given. —G. **Bigourdan**: Observations of nebulæ made at the Observatory of Paris. A summary of the last volume published in 1913.—H. **Le Chatelier** and B. **Bogitch**: The refractory properties of magnesia. A comparison of magnesia bricks either made in the laboratory from pure magnesia or commercial specimens. The resistance to crushing was measured at 15°, 1000°, 1300°, 1500°, and 1600° C. for two bricks, and at 15°, 1500°, and 1600° C. for the remainder. All the magnesia bricks show a sudden fall of resistance to crushing at a temperature depending on their degree of purity, and this explains why in practice it has been found that magnesia bricks stand less well in furnaces than silica bricks, although their fusing points, observed in the ordinary way without regard to resistance to crushing, are higher than the silica bricks.—Ch. **Richet** and H. **Cardot**: Regular and irregular antiseptics. The variation of effect from the mean of a large number of observations is taken as a measure of the regularity of action of antiseptics. Data are given for sixteen antiseptics, and the results summarised in four classes, very regular, fairly regular irregular, and very irregular antiseptics. Types of each of these classes in the above order are fluoride of sodium, creosote, phenol, and mercury salts.—G. **Scorza**: Abelian functions.—N. **Lusin** and W. **Sierpinski**: A property of the *continu*.—E. **Belot**: The exchange of solid material between stellar systems by meteorites with hyperbolic trajectory.—Mlle. A. **Hure** and M. G. F. **Dollfus**: The discovery of Lutecian millstone débris to the east of Sens (Yonne).—L. **Gentil** and L. **Joleaud**: The discovery of a small coal deposit in Tunis. This occurs in the neighbourhood of Medjez el Bab. The analyses given show it to be of high purity (average ash under one per cent.). Its stratigraphical surroundings are not those of the Coal Measures.—E. **Saillard**: The seeds of the sugar-beet. Before the war about four-fifths of the beet seed came from abroad, mainly from Germany. The sugar-beets of 1916 and 1917 have been practically as rich in sugar as in the ten years which preceded the war, although the production of sugar per hectare has been slightly less; the conditions of culture, however, have been less favourable. Without having recourse to German seed, results with the sugar-beet have been kept nearly the same as in the years preceding the war.—G. **Foucher**: The appearance of *Carausius morosus* ♂ and its longevity.—W. **Kopaczewski**: The poison of *Muraena helena*. A dose of 1·5 milligrams of this venom is fatal to a guinea-pig weighing 400 to 500 grams. It is remarkably thermostable, preserving its toxic properties after fifteen minutes' heating to 75° C.—Ch. **Dhéré**, L. **Baudoux**, and A. **Schneider**: The crystallisation of the acid hæmochromogen.—MM. **Heitz-Boyer** and **Scheikevitch**: The process of osseous regeneration in the adult.

BOOKS RECEIVED.

Trattato di Chimica Generale et Applicata all' Industria. Vol. i., Chimica Inorganica. By Prof. E. Molinari. Parte Prima. Pp. xiv+560. (Milano: U. Hoepli.) 12.50 lire.

The Cambridge Pocket Diary, 1917–18. Pp. xv+261. (Cambridge: At the University Press.)

With the French Flying Corps. By C. D. Winslow. Pp. 190. (London: Constable and Co., Ltd.) 3*s*. 6*d*. net.

Plant Materials of Decorative Gardening: The Woody Plants. By Prof. W. Trelease. Pp. 204. (Urbana: The Author.)

The Museum: A Manual of the Housing and Care of Art Collections. By M. T. Jackson. Pp. xi+280. (London: Longmans and Co.) 6*s*. 6*d*. net.

A Treatise on the Elements of Electrical Engineering. Vol. i., Direct and Alternating Current Machines and Systems. By W. S. Franklin. Pp. x+465. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 4.50 dollars.

The R.P.A. Annual for 1918. (London: Watts and Co.) 1*s*. net.

Charles Blount, Gent.: His Life and Opinions, to which is added the Second Apparition of Mrs. Veal. By Mysticus. Pp. 40. (London: Watts and Co.) 6*d*. net.

Memoirs of the Geological Survey. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for 1916. Pp. iv+56. Explanation of Sheet 248. The Geology of the South Wales Coalfield. Part iv., The Country around Pontypridd. By Dr. A. Strahan, R. H. Tiddeman, and Dr. W. Gibson. Second edition. Revised by Dr. W. Gibson and T. C. Cantrill. Pp. ix+160. (London: H.M.S.O.; E. Stanford, Ltd.) 1*s*. 6*d*. net and 3*s*. 6*d*. net respectively.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 1.

ROYAL SOCIETY, at 4.30.—The Reflexion of Light from a Regularly Stratified Medium: Lord Rayleigh.—Two Cases of Congenital Night-blindness: Sir William Abney.—Duration of Luminosity of Electric Discharge in Gases and Vapours. Further Studies: Hon. R. J. Strutt.—Surface Reflexion of Earthquake Waves: G. W. Walker.—Characteristic Frequency and Atomic Number: Dr. H. S. Allen.

CHEMICAL SOCIETY, at 8.—*pp*-3:4-Dinitrotetraphenylfuran: A. G. Francis.—Studies in Catalysis. VIII. Thermochemical Data and the Quantum Theory. High Temperature Reactions: W. C. McC. Lewis.—Studies in the Phenylsuccinic Acid Series. V. The Interconversion of the Esters of *r*- and *meso*-diphenylsuccinic acid: H. Wren and C. J. Still.—Metal-analogues of Carbon (deduced from solubility relationships). I.: S. S. Sahni.—"Uniform Movement" During the Propagation of Flame: W. Mason and R. V. Wheeler.—Studies upon the Sulphonation of Beta-naphthylamine: A. G. Green and K. H. Vakil.—The Limitations of the Balance: B. Blount.

MATHEMATICAL SOCIETY, at 5.—Annual General Meeting.—Tetrahedra in Relation to Spheres and Quadrics: J. H. Grace.—The Continuation of the Hypergeometric Series: Prof. M. J. M. Hill.—Restricted Fourier Series and the Convergence of Power-series: Prof. W. H. Young.—Invariants and Covariants of Linear Homogeneous Differential Equations: Prof. E. B. Stouffer.—The Simultaneous System of Two Quaternary Quadratic Forms: H. W. Turnbull.

MONDAY, NOVEMBER 5.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Patent Law in Relation to British Chemical Industry: Dr. F. W. Hay.

TUESDAY, NOVEMBER 6.

MINERALOGICAL SOCIETY (Anniversary Meeting), at 5.30.—Etched Crystals of Gypsum: Miss E. Smith.—The Mesosiderite-Grahamite Group of Meteorites: Dr. G. T. Prior.—Changing the Plane of a Gnomonic or Stereographic Projection: Prof. H. Hilton.—Cleavage Angles in a Random Section of a Crystal: Prof. H. Hilton.

ZOOLOGICAL SOCIETY, at 5.30.—Lantern Exhibition of Photographs of Mammals and Reptiles from the Society's Gardens: D. Seth-Smith.—Some Additions to the known Dragonfly Fauna of Borneo, with an account of New Species of the Genus Cœliccia: Lieut. F. F. Laidlaw.—The Use of the Names Plesiosauria and Sauropterygia: G. A. Boulenger.—Some Observations upon Concealment by the Apparent Disruption of Surface in a Plane at Right Angles to the Surface: J. C. Mottram.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: The Part Played by X-rays in the War: Captain G. W. C. Kaye.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Presidential Address: H. E. Jones.

WEDNESDAY, NOVEMBER 7.

GEOPHYSICS COMMITTEE, at 5.—Magnetic Surveys and Charts: Dr. S. Chapman.—Magnetic Survey of the United Kingdom: Dr. G. W. Walker.

FARADAY SOCIETY, at 8.—General Discussion on Pyrometers and Pyrometry: Introductory Address: Sir Richard Glazebrook.—High Temperature Production and its Measurement: Dr. E. F. Northrup (Trenton, N.J.).—Pyrometer Standardisation: Dr. Ezer Griffiths and F. H. Schofield.—The Advantage of Burying the Cold Junction of a Thermocouple as a means of Maintaining it at a Constant Temperature: R. S. Whipple.—The Automatic Control Measurement of High Temperatures: Richard P. Brown (Philadelphia).—Pyrometry applied to the Hardening of High-speed Steel: Prof. J. O. Arnold.—Determining the Temperature of Liquid Metals by means of Optical Pyrometers: Cosmo Johns.—Pyrometry from the Standpoint of Ferrous Metallurgy: Dr. W. H. Hatfield.—The Measurement of High Temperature by means of Pottery Materials: H. Watkin.—Base-metal Thermo-electric Pyrometers: C. R. Darling.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Reductase Test for Milk: Paul S. Arup.—Note on Jets for Burettes: J. H. Coste.—Analytical Examination of Acorns and Chestnuts: Julian L. Baker and H. F. E. Hulton.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.

GEOLOGICAL SOCIETY, at 5.30.—The Nimrud Crater in Turkish Armenia: Dr. Felix Oswald.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Structure, Evolution, and Origin of the Amphibia. I. The "Orders" Rachitomi and Stereospondyli: D. M. S. Watson.—The Enzymes concerned in the Decomposition of Glucose and Mannitol by *Bacillus coli communis*, II. Experiments of Short Duration with an Emulsion of the Organisms. III. Various Phases in the Decomposition of Glucose by an Emulsion of the Organisms: E. C. Grey.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—President's Address: C. H. Wordingham.

OPTICAL SOCIETY, at 8.—Certain Optical Stores Captured from the Enemy: Lt.-Col. A. C. Williams.

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UNIVERSITIES AND THE SUPPLY OF RESEARCH WORKERS.

ONE of the most important matters to which the Department of Scientific and Industrial Research has to give close attention is the supply of research workers by our universities and colleges. Military necessity has reduced the number—already small—of students being trained in research methods at these institutions; and an inquiry shows that the output of such students must be greatly increased after the war if sufficient men are to be available to widen the foundations of our staple industries by the application of scientific knowledge. People are accustomed to think of universities as educational institutions only, whereas the essential standard of value, and the measure of their greatness, is the worth of their contributions to the growth of knowledge.

This principle was set forth very decidedly in the report of the Duke of Devonshire's Royal Commission on Scientific Instruction and the Advancement of Science more than forty years ago.

"On no point," said the Commissioners, "are the witnesses whom we have examined more united than they are in the expression of the feeling that it is the primary duty of the universities to assist in the advancement of learning and science, and not to be content with the position of merely educational bodies. We entirely concur with the impression thus conveyed to us by the evidence, and we are of opinion that the subject is one to which it is impossible to call attention too strongly. We think that if the universities should fail to recognise the duty of promoting original research, they would be in danger of ceasing to be centres of intellectual activity, and a means of advancing science would be lost sight of which, in this country, could not easily be supplied in any other way."

At the time when these words were written scientific research was all but dead in England; and so far as the advancement of knowledge was concerned we occupied the position of a third- or fourth-rate Power. Scientific men were convinced that action was urgently needed in order to promote the future development of our national industries, but neither the State nor the old universities to which the appeal was made took any steps to remedy the existing condition of things. The result is that, whereas we should have had hundreds of research workers trained in university institutions and making their influence felt afterwards in industrial works for a couple of generations, their numbers have had to be counted in tens.

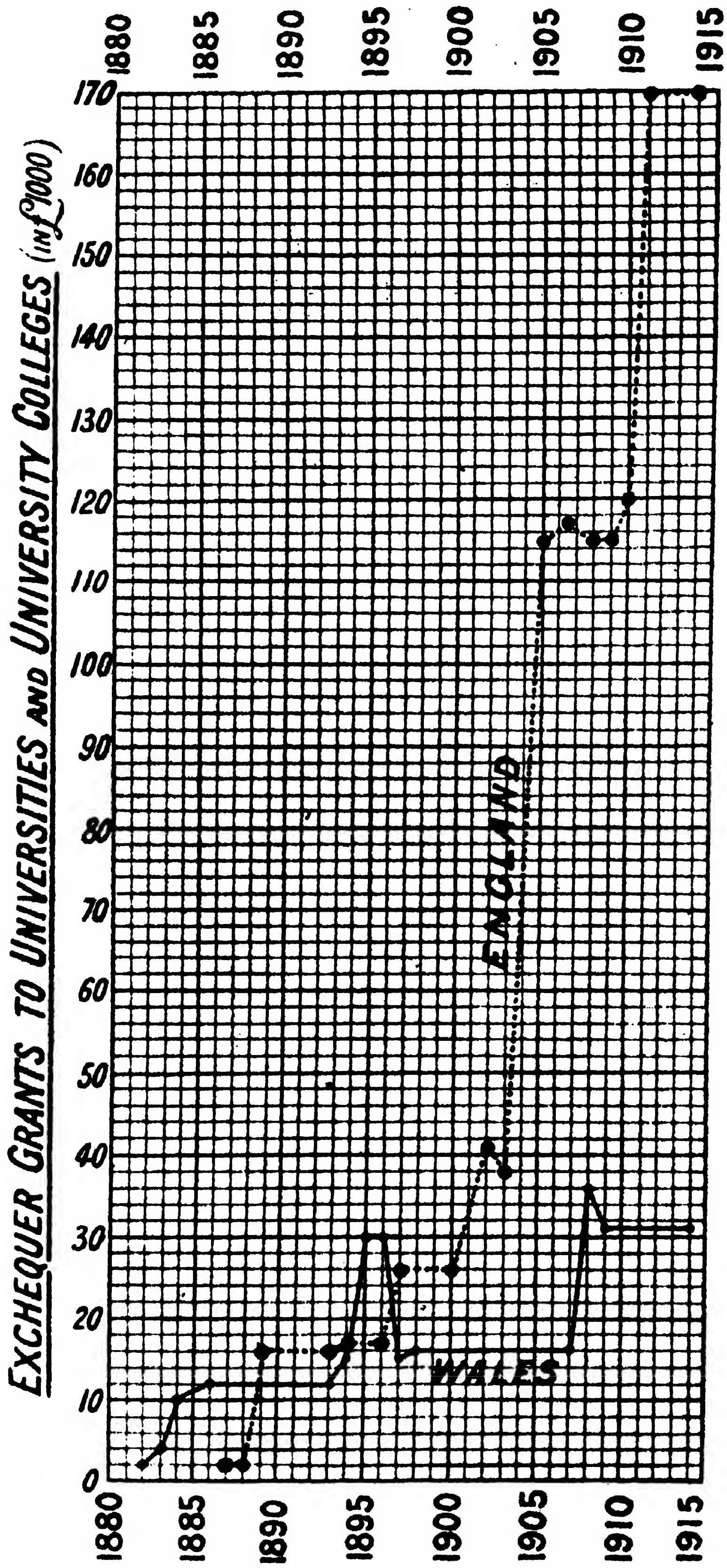
The State began to accept its responsibility for providing facilities for university education and research when in 1889 the House of Commons decided to recognise university colleges as national institutions by voting 15,000*l.* for distribution among them. This grant, which was recommended for the London colleges and Owens College, Manchester, by the Devonshire Commission in 1874, was increased to 25,000*l.* in 1897, in addition to a grant of 12,000*l.* to the three University Colleges of Wales. In 1904, a large and influential deputation urged upon Mr. Balfour, then Prime Minister, the need for further assistance to university education and research; and in announcing that the grant would at once be doubled, as well as redoubled in the following year, Mr. Balfour stated that the increase, which represented a capital sum of 3,000,000*l.* at 2½ per cent., was given as the result of the appeal made in 1903 by Sir Norman Lockyer in his presidential address to the British Association at Southport. Ten years later, in 1914, the Exchequer grants to universities and colleges in England and Wales amounted to 201,000*l.*: the stages of growth by which this sum has been reached are shown graphically in the diagram on p. 182.

It cannot be said, even now, that the funds at the disposal of our modern universities are sufficient to ensure the supply of advanced students and research workers demanded by the conditions of industrial development and the competition of other countries. There must be an increase in the number of scholarships from secondary schools to universities, and every inducement should be offered to promising students to train for research as a post-graduate study.

The Consultative Committee of the Board of Education, in a report on scholarships for higher education, published last year, estimated that the cost of the additional scholarships and other forms of endowment advised in the report would be about 340,000*l.* a year. It was recommended that the State provide, at an estimated annual cost of 67,500*l.*, about 250 scholarships for students from secondary schools who intend to pursue scientific or technical subjects at the universities, these scholarships to be awarded by the universities themselves, and to be renewable for a year or more after the conclusion of a degree course, upon the recommendation of a professor at the university, for the purposes of research in some branch of science or technology. An annual sum of 20,000*l.* was estimated to be required for these research scholarships.

The recommendations of the Consultative Committee have not yet been acted upon; but the scheme of the Committee of the Privy Council

for Scientific and Industrial Research provides for the establishment and award of research studentships and fellowships, as well as for the undertaking of specific researches and the assistance of institutions, or departments of institutions, for the scientific study of problems affecting particular industries and trades. In the first



report of this committee it was stated that grants had been recommended to an amount not exceeding 6000*l.* for about forty individual students and research workers, but the actual amount expended was only about 3550*l.* upon thirty-six workers; and the committee said in its second report: "Throughout our work has suffered in amount owing to the war, and we were unable to expend more than 14,524*l.* out of the 40,000*l.* placed at our disposal by Parliament for the financial year 1916–17." The committee recognises that a largely increased supply of competent researchers is necessary for the success of its work, and points out that the output of the universities is altogether insufficient to meet even a moderate expansion in the demand for research. It adds:—

"The annual number of students graduating with first- and second-class honours in science and technology (including mathematics) in the universities of England and Wales before the war was only about 530, and of these but a small proportion will have received any serious training in research. We have frequently found on inquiry that the number of workers of any scientific standing on a given subject of industrial importance is very limited. . . . The responsibility for dealing with the grave situation which we anticipate rests with the Education Departments of the United Kingdom. We shall be able to do something to encourage a longer period of training by the offer of research studentships and the like; but that will not suffice. It is useless to offer scholarships if competent candidates are not forthcoming, and they cannot be forthcoming in sufficient numbers until a larger number of well-educated students enter the universities. That is the problem which the Education Departments have to solve, and on the solution of which the success of the present movement, in our opinion, largely depends."

The report of the Consultative Committee already referred to suggests how the number of students might be increased by the State providing maintenance grants to enable selected scholars to continue their secondary education from the age of sixteen to that of eighteen or nineteen, by scholarships to universities from secondary schools and senior technical schools, and by the prolongation of scholarships for the purpose of training in research. Sir William Ramsay thought it preferable to subsidise teachers and teaching institutions with the object of increasing efficiency and reducing fees, rather than to add to the pecuniary resources of the student. His objection to the scholarship system was based chiefly on the method of award by competitive examination, by which it is impossible to estimate justly the capacity of candidates to deal with unfamiliar problems or ultimately to undertake research. This defect, however, may be obviated at the universities by placing the responsibility for the nomination for scholarships upon the professors under whom a student has been trained and making capacity for research a condition of award.

A considerable impetus to scientific study and training in research was given by the establishment of the now well-known science scholarships of the Royal Commissioners for the Exhibition of

1851. In 1889 the Commissioners announced their intention of appropriating from their accumulated funds an annual sum of not less than 5000*l.* a year for the foundation of scholarships to enable the most promising students in selected colleges to continue their studies beyond the ordinary period of three years, provided that they show high promise for advancing science and its applications. The scholarships are awarded, not by examination, but upon the nomination of the institutions to which they were allotted, and their value is 150*l.* a year for two years, with possible extension to three years. The principle of selection was decidedly in advance of any scheme existing at the time, and the value of the scholarships is sufficient to encourage students of high capacity to devote time to research.

These scholarships are given for research only, and they are not allowed to be held at the institution where the scholar has graduated. It is acknowledged that nothing has done so much to promote free interchange among the universities of the Empire, and also with those of other countries, as the 1851 Exhibition Scholarships, and they might well form the nucleus of a great system of scholarships and fellowships expressly designed to promote that end. Since 1891 the Commissioners have appointed, on the nomination of universities throughout the Empire, in every year twenty research scholars. The number of workers thus subsidised has been small in comparison with the needs of the Empire; but it is universally admitted that the results have far more than justified the expenditure. The Consultative Committee, in its Report on Scholarships for Higher Education, notes, however, that in 1916 out of 305 scholars known to be at work, only seventy-nine were engaged in industry, as against 194 engaged in educational work and thirty-two in Government service. Moreover, of the seventy-nine engaged in industry, twelve had appointments in the United States, and seven more outside the British dominions.

The probable reason why two-thirds of these capable research students became teachers at the end of their scholarship periods is that suitable posts were not open to them in industrial works. This waste of capacity for original investigation will not be avoided unless manufacturers offer to trained researchers positions and prospects much more attractive than have been customary. Improvements have certainly been effected since the opening of the war, and the signs are favourable that the demand will increase when peace is restored. Meanwhile, the governing bodies of our universities and technical colleges should consider whether their resources will enable original investigators on their staffs to be relieved of the necessity of preparing students for examination in order to train the most gifted of them in the methods of research. Unless this relief is given, and the first duty of the occupant of a scientific chair in an institution of university rank is recognised to be the promotion of research, the award of scholarships will be in vain, and the introduction of graduates into industry will not lead to the developments necessary to make our future position high and secure among the foremost nations of the world.

BRITISH ORNITHOLOGY.

(1) *A Bibliography of British Ornithology from the Earliest Times to the End of 1912, including Biographical Accounts of the Principal Writers and Bibliographies of their Published Works.* By W. H. Mullens and H. Kirke Swann. Parts i.–vi. (London: Macmillan and Co., Ltd., 1916.) Price 6*s.* net each.

(2) *British Birds.* Written and illustrated by A. Thorburn. In 4 vols. Vol. iv. Pp. vii+107+plates 61–80. (London: Longmans, Green, and Co., 1916.) Price, 4 vols., 6*l.* 6*s.* net.

(1) WITH the issue of the sixth part Messrs. Mullens and Swann bring to a conclusion their great "Bibliography of British Ornithology," forming a volume of more than 700 pages. This should, perhaps, be considered as only the first section of the whole work; for hopes are held out that it is to be followed by a geographical bibliography of the same subject, which will be another very laborious and most useful undertaking.

At the foot of their prefatory note the authors disarm criticism by very fittingly quoting from Dr. Samuel Johnson's preface to his Dictionary: "In this work, when it shall be found that much is omitted, let it not be forgotten that much likewise is performed." Much, indeed, has been performed in this monumental work, and as to omissions, some sixteen pages of addenda and corrigenda go far to supply any there may have been. This later matter has been printed on one side of the paper only for the convenience of those who wish to cut it up and insert in the proper places in the work.

We have already, when noticing the earlier parts, referred to the general plan of this work, to its far-reaching scope, and to its going back to the earliest days of anything in the shape of a study of our British birds. It goes back, indeed, to Bartholomæus Anglicus, who flourished about 1230–60, and whose "De Proprietatibus Rerum," in the translation printed by Wynkyn de Worde about 1495, is one of the earliest printed works on natural history in the English language. A feature of this final part is the remarkably full and able bibliography of the "Natural History of Selborne." The many

editions are here arranged in groups, for of some of them there have been many issues, as, for instance, that of the popular Capt. Thomas Brown, which either as a new edition or as a re-issue has appeared more than a score of times. A list of separate books and reprinted articles dealing with White and Selborne is added. This final part also contains lists of the bibliographical and biographical works which have been consulted, of the periodicals cited, and of the special abbreviations used in the present work.

The biographical side of the book can scarcely be considered so satisfactory as the bibliographical portion. To begin with, it is avowedly, and by the plan of the work unavoidably, incomplete as a biography of British ornithologists; and, indeed, it never professed to be otherwise. The aim of the authors has been "to give a biographical account of each author or co-author of a separately published work," the result being a biography of the greater part of our ornithologists—and of a good many other people, too: to wit, the authors of works which mention birds, but are of a worthless nature, ornithologically speaking at all events. At the same time we miss well-known names of really good ornithologists who have done some of the best work, and whose writings will be referred to long after more popular and showy books have sunk into oblivion, as many of them had already done. But we miss the names of these good men in the present work because their published writings appeared only in periodicals, transactions, and the like, and were not separately published. The second portion, or continuation, of the bibliography, already alluded to, will, however, doubtless set this right and complete the biography of British ornithologists. As to the biographies given of living ornithologists—a delicate subject—they vary greatly in extent; and as in this respect they probably depended a good deal on the amount of information furnished by the subjects of the respective notices, they differ greatly, as may readily be imagined, in the kind, as well as in the extent, of the information they afford. British bird-men will read them all with considerable curiosity.

(2) Mr. Thorburn and his publishers are to be congratulated on the completion, by the issue of vol. iv., of this famous and beautiful set of coloured plates of the birds on the British list. A book which stands high in the fine arts, and from its price (low as this is for all these pictures) must be looked upon as one of the luxuries of life, has been begun and finished during the Great War. The volume now before us includes the wading birds (plovers, sandpipers, etc.), the terns, gulls, skuas, auks, divers, grebes, and petrels. They are beautifully drawn and coloured and true to Nature, though in one or two cases it may seem to some people that the peculiar attitudes are a little exaggerated. The colour reproduction leaves little or no fault to be found. But the former remark does not apply to the valuable and most interesting drawing of a "drumming" snipe, which, "made from sketches taken in the spring of 1914 after watching the bird, shows the position of the outer tail-feathers, spread out and separated only during the descent." The letterpress notes are concise, but most useful, informing, and very much to the point. To those who wish to have a good coloured figure of every species of bird which has ever occurred in a wild state in this country, it may be said that this is the only work which can satisfy them. A more desirable book for the country-house library or billiard-room it would be difficult to find.

THE NUTRITION OF FARM ANIMALS.

The Nutrition of Farm Animals. By Dr. H. P. Armsby. Pp. xvii+743. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 11s. net.

GREAT advances have been made in the study of animal nutrition since Dr. Armsby first began his investigations at the State College of Pennsylvania and wrote his "Manual of Cattle Feeding" and his "Principles of Animal Nutrition." He has now brought together the material and presented it anew. There has been no fundamental upheaval since the last edition of his earlier book appeared, but there have been remarkable changes in details, and in consequence the picture is now very different from what it was, though it is still recognisable in its main features.

In the first section, dealing with the composition of plants and of the animal body, considerable advances are recorded in our knowledge of the lipoids, the proteins, and the non-protein nitrogenous substances.

The second section deals with digestion and resorption, and gives a useful summary of the American and German investigations. Considerable interest attaches to the digestion of carbohydrates. For long it was supposed that the cellulose of feeding-stuffs was indigestible: no digestive enzyme was known to attack it, and there seemed no mechanism for breaking it down. Henneberg and Stohmann proved that it was digested, and at a later date both Wildt and Zuntz showed that the process occurs in the portions of the alimentary canal where the food stagnates, *i.e.* in the paunch of ruminants, and in the cæcum and colon. Later investigations indicate that it is brought about by organisms inhabiting the alimentary canal, and that it gives rise to considerable quantities of carbon dioxide and methane, as well as various acids, mainly acetic and butyric. These are resorbed, as salts, which appear to constitute the sole contribution that cellulose makes to the nutrition of the animal body. One cannot help wondering whether better use could not be made of the cellulose by subjecting it to some chemical or bacterial treatment before using it. Apparently the pentosans are digested in the same way, and also the mucilage of linseed cake, according to Neville's experiments, which, however, the author does not mention. Bacteria cause

some decompositions of protein, although Kellner's investigations indicate that the animal does not benefit thereby. The decomposition by bacteria is prevented in the stomach by the hydrochloric acid of the gastric juice, and in the lower part of the large intestine by the progressive resorption of water from the intestinal contents. In the small intestine, however, the organisms are more active, giving rise to ammonia, phenols, indols, etc. The two latter are largely resorbed; they are of little, if any, use to the animal—indeed, they are poisonous; they combine, however, with other substances and are excreted in the urine as the so-called ether-sulphates.

Considerable progress has been made in our knowledge of the utilisation of fat. At an early stage in the mobilisation of the reserve in the adipose-tissue cells the fat becomes hydrolysed, yielding glycerol, which, perhaps, serves as a source of dextrose, and a fatty acid, which is oxidised. Dakin and others have shown that the oxidation of the acid begins at the β carbon atom (*i.e.* at the second from the COOH group), and results in the splitting off of two carbon atoms at a time, yielding water, carbon dioxide, and another fatty acid containing two fewer carbon atoms than the original one, with which the same process of erosion is repeated. It is not yet clear, however, how the animal utilises formic, acetic, and propionic acids, although it undoubtedly does so.

The author then proceeds to discuss the various types of experiments made by investigators in animal nutrition: the simple feeding trial, in which the gross gain in body-weight is measured for a particular ration; the digestibility experiment, which requires more careful measurement and aims at determining what proportions of the various food constituents have been digested and resorbed; the "balance experiment," in which respiration determinations are added to the foregoing in order to make up a balance-sheet showing exactly what has become of the food; and, finally, the elaborate calorimeter experiment, in which an attempt is made to trace the energy changes involved.

The author is well known for his investigations on the energy relationships of nutrition, and his own beautiful calorimeter at State College is the envy of many another institution. He devotes considerable space to this aspect of the subject.

Incidentally, he makes an interesting comparison between the efficiency of a horse and that of a power plant. He finds the total useful work done by a working horse was 2·8 therms; the gross energy of the ration was 55·8; the over-all efficiency was, therefore, 5·1 per cent. The animal worked six hours per day. Supposing his bodily machinery was stopped for the other eighteen hours (as an engine would be), and he was charged with only a fourth of his maintenance requirement, the over-all efficiency would be raised to 6·3 per cent.—about that of a modern American locomotive. In actual practice the conditions with an animal are very much as if it were necessary to keep up a full head of steam for twenty-four hours, or to run an internal-combustion motor continuously, although work is only done for part of the time.

The author attaches less importance than usual to starch equivalents, which he considers may obscure the energy relationships. Altogether the volume is very interesting, and will be read by agricultural teachers with much pleasure.

ULUGH BEG'S CATALOGUE OF STARS.

Ulugh Beg's Catalogue of Stars, revised from all Persian manuscripts existing in Great Britain, with a vocabulary of Persian and Arabic words. By E. B. Knobel. Pp. 109. (Washington: Carnegie Institution, 1917.) Price 2 dollars.

THIS work forms a sequel to Mr. Knobel's edition of Ptolemy's Catalogue (see NATURE, vol. xcvii., p. 282). Owing to the war he has only been able to use codices existing in England, but these are fortunately rather numerous, and twenty-two Persian and Arabic MSS. have been collated. A partial collation of three Persian MSS. at Paris by the late Prof. C. H. F. Peters has also been utilised.

This catalogue of 1018 stars, the first original catalogue since that of Ptolemy, is founded on observations made during the reign of Ulugh Beg, a grandson of Tamerlane, at his observatory near Samarkand, the epoch being A.D. 1437. It was published in 1665 by Hyde from three codices at Oxford, and this edition was reprinted in 1767 in the collected edition of Hyde's works. It was again issued by Baily in 1843 in his edition of ancient star-catalogues, in which the stars were for the first time identified and the modern designations given. Mr. Knobel's edition differs from Hyde's not only by being founded on a far greater number of codices, but also by giving the places of the stars for 1437 computed from modern star-catalogues (by Peters) and a comparison of these with Ulugh Beg's places.

No particulars about the instruments employed or the methods of observing are known. Peters was the first to notice that the minutes of the longitudes are generally of the form $3n+1$, while the minutes of latitudes are multiples of 3, as if the circles of the instrument were graduated to $3'$ and some correction of $1'$, $4'$, or $7'$ had been applied to the longitudes. Ulugh Beg states that twenty-seven stars in Ptolemy's Catalogue were too far south to be observed at Samarkand, and that their places were, therefore, borrowed from Ptolemy, allowance being made for precession. Mr. Knobel has found that the longitudes of four other stars were derived in the same way, and were not observed. In addition to these, there are at least eighty-two pairs of stars of which the longitude of one star only was observed, while that of the other (a few degrees distant) was obtained by adding or subtracting Ptolemy's difference of longitude. The latitudes of sixty-eight stars were simply copied from Ptolemy, and there are at least forty-four pairs

of stars of which the latitude of one star only was observed, while that of the other was obtained by means of Ptolemy's difference of latitude. Therefore, the longitudes of only about 900 stars were actually observed, and the latitudes of about 878 stars. But there is a strong suspicion that the original observations should be still further reduced, as there are some forty or fifty stars the errors of the places of which resemble the errors of Ptolemy, and thus suggest a derivation from the Almagest. These very interesting results of Mr. Knobel's examination of the catalogue have escaped the attention of all previous historians of astronomy.

The comparison with modern star-places shows that the accuracy of Ulugh Beg's observations was not much superior to that of Ptolemy's. Mr. Knobel reproduces a drawing of an altazimuth from a Persian MS. in the British Museum (a treatise on astronomical instruments), which shows the use of diagonal scales for subdividing graduations. As the MS. dates from A.D. 1700, the influence of knowledge derived from Western sources is not excluded. But as diagonal scales were known to Levi ben Gerson, a Spanish Jew who died at Avignon in 1344, it is very possible that some later Arabian observers may have employed them. Judging from his star-places, Ulugh Beg scarcely did so. We congratulate Mr. Knobel on this completion of the long labours of Prof. Peters and himself on ancient star-catalogues. J. L. E. D.

OUR BOOKSHELF.

A Chemical Sign of Life. By Shiro Tashiro. (The University of Chicago Science Series.) Pp. ix+142. (Chicago: University of Chicago Press; London: Cambridge University Press, 1917.) Price 1 dollar or 4*s.* net.

DR. TASHIRO gives a useful and readable summary of the results which he has obtained on the production of carbonic acid in nerve and in seeds by the employment of an ingenious microchemical method. He regards the evolution of this gas as a sign of life analogous to the "blaze currents" described by Dr. Waller. The magnitude of the CO_2 production which he observes in nerve fibres has raised doubts as to the exact significance to be ascribed to the results obtained. The author deals with some of the criticisms which his work has evoked.

Morphology of Gymnosperms. By Profs. J. M. Coulter and C. J. Chamberlain. Revised edition. Pp. xi+466. (The University of Chicago Press.) Price 5 dollars net.

THIS important work was reviewed at length in the issue of NATURE for August 10, 1911 (vol. lxxxvii., p. 171). The revised edition is in no sense rewritten, but important changes and additions occur, the more important of which are in the chapter on Cycadales and in the bibliography. A supplementary list to the latter adds 150 titles to the 484 of the first edition.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Tidal Energy Dissipation.

MR. STREET is in error in attributing to me (NATURE, October 25, p. 145) the "contention that viscous action in a solid earth cannot be an appreciable cause of the slowing of its rotation." I have never made any such assertion, it is opposed to my personal opinion, and in the present state of knowledge it is quite impossible either to affirm or to deny a statement of such definiteness. His criticisms of the law of viscosity used by me (M.N., R.A.S., vol. lxxvii., pp. 449–56) are confined to its precise mathematical form, to which I attach little importance, and do not touch the physical conceptions underlying it, which are fundamental. The mathematical argument was only a numerical illustration of the order of magnitude of the effects to be expected from these.

The theory that viscosity in the solid earth is the cause of the lunar secular acceleration requires its effect to be considerable for variable stresses with periods of the order of a day. If, then, the viscosity is of such a character as to permit an indefinite flow when a constant stress is applied for a long enough time, then for stresses with a period of a year or more the substance will have time to flow like a liquid, keeping approximately the hydrostatic form throughout the changes. Hence the Eulerian nutation, a long-period vibration depending for its existence entirely on solid rigidity, could not persist. Similarly, annual variations in the distribution of mass over the surface would be compensated by internal flow, and there could therefore be no annual variation of latitude.

If, on the other hand, the viscosity is not of a type that permits indefinite flow, the strain when a constant stress is applied must tend to a finite value, and afterwards remain approximately constant. The effect of viscosity must then be limited to the initial stage. In the case of a periodic stress the period of which is long compared with this initial stage, the rigidity will be of much more importance than viscosity, and the substance will behave nearly as if perfectly elastic. On the other hand, if the period is short in comparison, viscosity will be of greater importance. This is supported by the fact that if the viscous forces are directly proportional to the rate of straining, as is inherently probable on account of the analogy to electric resistance and fluid viscosity, the same is found to hold. On such ideas the law I called that of "firmo-viscosity" is based. If, then, the effect of such viscosity is considerable when the period is twelve hours, it must be more important than elasticity when the period is only a few seconds, as in the case of earthquake waves. Thus the transmission of these waves would be prevented. It follows that firmo-viscosity is absent from the earth so far down as seismic waves travel; it may, however, be important at still greater depths.

If on the application of a constant stress to a body the strain at once assumed a finite value, then slowly increased for a few days, and afterwards remained constant, the viscous properties of such a body would bear a close resemblance to those of the earth as a whole. In this case, however, the rigidity found from the Eulerian nutation should be much less than that found from earthquakes, which does not appear to be the case. This suggestion, therefore, alters the difficulty without removing it.

Mr. Street's statement that an infinite number of laws could be found that would satisfy the conditions is obviously true, but any of them, by what has been said above, would necessarily bear a strong resemblance to the firmo-viscous law, and the simplest hypothesis that is acceptable on physical grounds is that of firmo-viscosity near the centre.

I am unaware of having modified my views on this question in any vital matter save by addition; in any case, I fail to see that such modification would afford any argument against my present position.

HAROLD JEFFREYS.

St. John's College, Cambridge.

THE PROPOSED MINISTRY OF HEALTH.

WHEN Lord Rhondda some months ago declared that there was a great deal of overlapping in connection with the work of public health administration, and that a separate Ministry was urgently required, of the many who agreed with him few, if any, seemed to be prepared to tell him in detail how he might set about abolishing the overlapping and constructing the Ministry. The faults of the system under which health service was given to the public were plain to see. The reason for their existence was also obvious.

There was no real planning when the scheme was initiated; no one grasped the importance of health work or foresaw that it would and must grow. Even the enthusiasts underestimated the importance of the cause they had at heart, and the persons they induced or compelled to listen to them and to take action naturally also underestimated it. Both parties builded worse than they knew. They did, indeed, the worst thing possible: they chose the wrong foundations, and they did not look ahead and plan for future extensions.

Imbued with the dread, so common in relation to central administration in this country, that trouble would follow if there was any suggestion to form a new department; believing that, so far as Government work is concerned, the safest plan is "more men and fewer of them," they canvassed the existing departments for one or more upon which the new duties might be placed. Not unnaturally, they eventually found a department. That concerning itself with Poor Law administration, now known as the Local Government Board, was obviously the proper one to take on the new work. As organisation went, it was fairly well organised. It had some doctors and a number of lawyers attached to it, and through its officials of a lower grade it was in touch with the class of person whose health required most looking after.

The easy and pleasant task of placing new work in old departments, once commenced, was continued. As new lines of work were found and the necessity for doing something along these lines was recognised, it became essential once more to look round for departments to which the duty of doing what was required might be entrusted.

In some cases the Local Government Board felt unable or disinclined to undertake it, and it was taken round until another department more suitable or complaisant was found. There came at length a time when health work was regarded as the most important of all the public works, and the necessity for seeking departments to accept fresh work in this field ceased. Actually the departments began to compete for it, and it was counted as essential by each that it should have part of the nation's health work to do.

It was regarded as nothing that there should be absolute lack of uniformity and co-ordination; that work on behalf of the public health was so organised that one part, the largest perhaps, was at the Local Government Board with Poor Law administration, another part at the Board of Education, and portions more or less important at the Home Office, the Insurance Commission, the Board of Agriculture, the Board of Trade, the Admiralty, and the Ministry of Munitions.

Recognition of the fact that such a distribution of important work is undesirable and likely to lead to inefficiency, overlapping, and waste of money is easy. Those who recognised it, however, did little more than this. If they had anything to offer in the way of suggestions as to how the existing difficulties might be overcome and the Ministry of Health that was considered so indispensable formed, they did not advertise the fact very widely.

The one scheme that has been given publicity was drafted by certain persons interested mainly, apparently, in State insurance and bodies concerned with its administration. Quite obviously this scheme had for its chief intention the belittling of the importance of the work done by other departments, and particularly that of the Local Government Board, the body at present regarded as the central health department. This scheme and a Bill founded upon it the Prime Minister was asked to bless by a deputation that waited upon him on October 11. Wisely he refused to do so, pointing out that the matter bristled with difficulties, and hinting that consideration, involving a vast amount of time and trouble, would have to be given to it.

It is certain that long and serious consideration will be necessary. The drafting of a scheme is not the work of half a dozen persons known only to one class of the population and knowing but one side of health work. To suggest that a Commission would be the best body to deal with the subject is almost to ask to be regarded as ridiculous. Nevertheless, there is something to be said in favour of a suggestion that a Commission should be appointed, with the proviso that it must be something more than the ordinary body that meets and reports and rests.

The Ministry of Health Commission must consist of individuals possessing business ability and capable of taking a broad view, if the very best is to be done for the health of all the public. Further, it must be given a clear reference and a free hand; the right even to embody its recom-

mendations, not in a report, but in a Bill, might be conferred upon it. If it is necessary to pass an Act of Parliament to allow of the creation of such a Commission and the giving of such powers, then the passing of such an Act must be the first step. The matter is so important as to justify such procedure. The difficulties with which it is attended, mainly because of the number of departments and interests that are involved, render it almost hopeless to expect that a solution will be found if only the methods regarded as constitutional are available.

PROF. ADOLF VON BAEYER, For.Mem.R.S.

THE announcement in the *Times* of September 8 of the death of Prof. Adolf von Baeyer at Starnberg, near Munich, in his eighty-second year, must have come as a shock to his many pupils in this country. It was known to several of us that he had not been in good health for some years, but the quiet life which he led at his beautiful home on the shores of the Starnberger See seemed to benefit his health so much that his sudden decease, even at his advanced age, was quite unexpected. It is questionable whether any teacher or investigator ever exerted a greater influence on the development of chemical science, and especially of organic chemistry, than Baeyer has done, for not only was he a great teacher whose pupils are to be found in every civilised country, but his researches have also laid many of the foundations on which the amazing structure of modern organic chemistry has been raised. Apart from the interest which always attached to his published work, it is probable that his main influence on chemical thought was due to his magnetic personality and power of imparting to others some of his enthusiasm for discovery.

For many years, and particularly during the period 1880–1900, it was the custom for the large majority of those who wished to come into contact with the later developments of experimental method to attach themselves, for a short time at least, to the laboratories at Munich. The power which Baeyer exercised in connection with the progress of chemistry in Germany can scarcely be better illustrated than by the fact that during these years almost every professor of chemistry in Germany of the first rank was a pupil of Baeyer. Among these we find, for example, the names of E. Bamberger, L. Claisen, Th. Curtius, Emil Fischer, Otto Fischer, P. Friedländer, C. Graebe, L. Knorr, C. Liebermann, Victor Meyer, H. v. Pechmann, J. Thiele, and R. Willstätter.

Baeyer's influence on the development of chemical industry, and especially of the colour industry, was not less remarkable, for in every works were to be found such men as Caro and Duisberg, Homolka and Weinberg, and a host of others who had learnt their chemistry and acquired their methods of research in the laboratories at Munich. If inquiry is made into the reason for the wide influence which Baeyer has exerted on chemical thought, it will be universally agreed that this has been due in the main to his extraordinary enthusiasm for research and the keen joy which he felt and expressed when he had succeeded in producing some new substance of importance which he had probably been seeking for many months, and possibly for years. On such occasions he used to walk about the laboratories beaming with delight and discuss his latest discovery and its probable consequences with his assistants and advanced pupils. His enthusiasm fired the enthusiasm of his hearers, and unquestionably did much to awaken and stimulate the desire to make discoveries and achieve something perhaps of equal importance. Baeyer was essentially an experimenter, and had little real interest in the development of new theories, although some of his views, such, for example, as those on the constitution of benzene, the structure of oxonium salts, the cause of colour in the triphenylmethane series, and the mechanism of the formation of sugar in the plant, were valuable contributions to theory, and his well-known "Spannungs Theorie" was a brilliant conception of real value in connection with stability in ring structures.

It was Baeyer's habit to adjourn to his private laboratory directly after his early-morning lecture, for perhaps an hour, in order to carry out any experiments which had occurred to him after the close of the previous day's work and to discuss the day's programme with his assistant. He would then walk through the research laboratories and talk over any difficulties with those with whom he happened to be working, and with others whose work happened to interest him. Baeyer's custom was to work himself with comparatively few of those engaged in research in his laboratories, and he left to the *Privatdozenten* almost entirely the supervision of the *Doctorarbeiten*.

Unless something of real interest had happened, it was usual for those working with him to tell him at once that there was nothing to report, and, in this way, Baeyer frequently made the tour of the large laboratories so rapidly that he was back in his private laboratory soon after eleven o'clock, and the whole of the rest of the day was spent at his own work. His private laboratory—a large and very well lit room—usually contained, besides one private assistant, some other researcher in whose work he was specially interested, and it was not unusual for such a student to remain in the private laboratory for weeks at a time. Such an experience was, of course, of the utmost value to those who were fortunate enough to enjoy the privilege; in such circumstances it was impossible not to be profoundly influenced by the skill, patience, and resource with which the experimental difficulties of so many intricate problems were gradually overcome. His equipment for research consisted almost entirely of test-tubes and glass rods, and it rarely happened that he used anything larger than quite small beakers and flasks. Large wooden racks containing hundreds of test-tubes were always at hand, and it used to

be said that these test-tubes, after the usual wash, were subjected to a further cleaning, first with alcohol, and then with distilled water. Baeyer always insisted that the occurrence of a chemical change can be more easily observed and its course more closely followed with small quantities of material and the aid of a test-tube and glass rod than by the employment of a hundred grams of substance and large flasks or beakers. That this view was undoubtedly correct is demonstrated not only by the brilliant results which Baeyer himself achieved with such simple means, but even more conclusively by the fact that his pupils, if perhaps reluctantly at first, all ultimately adopted his method of work. There can be no doubt that the discovery and careful characterisation of so many substances, and the publication of so much important work covering such a wide field, would not have been possible had not Baeyer early acquired the habit of working with small quantities of material.

Baeyer's immense power of work is shown by the fact that, until his eightieth birthday, he delivered his usual lectures on five mornings of each week and continued to experiment in his laboratory with his usual unflagging energy. Had the war not robbed him of his private assistant and laboratory staff, it is probable that he would have gone on even longer. He confided to one of his intimate friends that work in the laboratory gave him as much pleasure after fifty years' toil as at any time during his career, and to the last he took the greatest interest in any developments in the domain of natural science which were brought to his notice. It is well known that he viewed with disfavour and apprehension the growing domination of military power in Berlin and Prussia generally, and it was mainly, no doubt, for this reason that he refused to accept the invitation to Berlin on the death of Hofmann.

Adolf Baeyer was born on October 31, 1835, in Berlin, and he spent his early life in the house (242 Friedrichstrasse) of his grandfather, which at that time was a centre of the literary life of Berlin, and it thus came about that Baeyer was brought up in a literary atmosphere. He always referred to this early intimate contact with literature with pleasure, and considered that the love for literature which he acquired in those days was of great service to him throughout his later career. Baeyer's chief interest in these early days seems to have been for botany and in living things generally, and his first contact with chemistry was on his ninth birthday, when his father gave him a copy of Stöckhardt's "Schule der Chemie."

In his "Erinnerungen aus meinem Leben," which he wrote for the celebrations organised in connection with his seventieth birthday, he tells us that he converted a passage in the house into a small laboratory, and there carried out the usual dangerous and unpleasant experiments associated with early youth. It was during this time that he made his first discovery, that of the double salt, $CuCO_3,Na_2CO_3,H_2O$. The activity of the small laboratory does not seem to have been altogether appreciated, and the poet, Paul Heyse, who was a frequent visitor at the house, had reason to protest:

> Es stinkt in diesem Haus gar sehr
> Das kommt vom Adolf Baeyer her.

When he entered the university Baeyer seems at first to have entirely forsaken his chemical experiments and to have devoted himself to physics and mathematics; but the interest in chemistry soon returned, and in 1856 he entered Bunsen's laboratory at Heidelberg. After studying the methods of analysis in this famous laboratory for a year, he came under the influence of Kekulé, whom he afterwards followed to Ghent, and whom he always considered was his real teacher.

Baeyer obtained the Ph.D. degree in 1858; his dissertation, "De arsenici cum methylo conjunctionibus," presented and printed in Latin, was a difficult and important piece of accurate work and a great achievement for so young an investigator, especially as it was commenced and carried out entirely on his own initiative. In the spring of 1860 Baeyer returned to Berlin and became *Privatdozent* at that university, but in the same year he was appointed teacher in organic chemistry in the Gewerbe Institut, an institution which later developed into the Berliner Technische Hochschule. The foundations of many of Baeyer's most important researches were laid during the next few years, for we find him publishing papers on the uric acid group, mellitic acid, isatin and indigo, the reduction of benzene carboxylic acids, acetylene derivatives, etc., subjects which later developed into the classical memoirs with which his name is so intimately associated. Among the distinguished workers who were attracted to Baeyer's laboratory during this time we find the names of Graebe, Liebermann, Nencki, and Victor Meyer, and it was in 1866 (*Annalen*, cxl., 295) that the method of reduction by distillation with zinc dust was elaborated which enabled Graebe and Liebermann to demonstrate that alizarin is a derivative of anthracene, and thus to proceed with the synthesis of this important colouring matter.

The next stage in Baeyer's career began in 1872, when he was appointed professor of chemistry in Strasburg, and it was here that he numbered among his pupils Emil and Otto Fischer and H. Caro, and produced many papers, of which those dealing with the phthaleins are probably the most important. Baeyer stayed in Strasburg for three years, and then proceeded in 1875 to Munich, where he remained for forty years, and it was in the Munich laboratories that most of his famous researches reached maturity.

It is impossible to mention even the titles of the long series of papers which appeared with such regularity during this long period, and are so well known to every student of chemistry. Mention may, however, be made of his researches on the phthaleins, the reduction of the phthalic acids, the constitution of benzene, indigo and its derivatives, and last, but not least, the researches on the polyacetylene derivatives, which are marvels

of experimental skill and have perhaps never been sufficiently appreciated.

His later researches were concerned with the peroxides, the constitution of Caro's acid, and particularly with the constitution of the oxonium salts and of the coloured derivatives of triphenylmethane, and his last research, published in 1911 together with Jean Piccard, was on the oxonium salts derived from dimethylpyrone (*Annalen*, ccclxxxiv., 208, 224).

W. H. PERKIN.

NOTES.

THE announcement made by the Admiralty on Saturday that "an attack was made on our vessels patrolling the Belgian coast by an electrically controlled high-speed boat" (which was destroyed in the attempt) recalls the various suggestions and experiments made, ever since Hobson's "bottling" exploit at Santiago, to devise an unmanned craft capable of being steered for attack from a safe distance. Brennan's wire-controlled torpedo was a clumsy device compared with the radiotelegraphic control worked out by J. H. Hammond in America, and tested before the present war commenced. There is no doubt that it is possible to construct a craft steered by wireless which will attack and hit a target two or three miles off. The difficulty of seeing the craft at such distances from the steering station can be overcome at night by attaching to it a light directed backwards and invisible from the target. But the main objection to wireless control is that it can be "jammed" by the enemy. To meet this difficulty it has been proposed to use a selenium control actuated by a searchlight. There is little doubt that this can be successfully worked over a range of several miles, but here again the objection is that something must emerge and be illuminated, and that this something is liable to destruction by the enemy. The question resolves itself into one of adaptability to exceptional circumstances. It will be interesting to learn which of the various possible constructions has been adopted by Germany. The Press Association is authorised to state that four electrically controlled boats have already been destroyed. The boat destroyed last week had a petrol engine, was electrically controlled from the land, and was convoyed by an aeroplane.

AN article of considerable length upon the stabilisation of aeroplanes and ships by means of the gyroscope appears in *La Nature* for October 20. The apparatus designed by Sperry for these purposes is described in some detail. The application to the case of ships and the superiority of Sperry's stabiliser to that of Schlick are fairly well known, but the application to the aeroplane is perhaps less familiar and deserves a word of comment. The claims made for the apparatus are that it relieves the pilot of all control except that of the rudder, and that the machine will continue to fly for almost any length of time at the attitude for which the gyro controls are set. But this is also true of an inherently stable machine, and inherent stability can be obtained without any addition of weight and without any increase of head resistance such as that due to the windmills which drive the servo-motor and generator of the Sperry apparatus. The Sperry stabiliser may be of some utility for large aeroplanes used for commercial purposes or long passenger flights, but it is certainly not required for military aircraft. One of the greatest necessities for the military machine is flexibility of control and ability to execute manœuvres, such as looping, spinning, and steep nose-diving. For such a machine the Sperry stabiliser is worse than useless; indeed, the construction of the apparatus appears to be such that looping the machine would completely derange the adjustment. The additional weight of the apparatus and the extra head resistance involved are serious drawbacks to its use in any machine, and the great complexity of its mechanism is antagonistic to the best principles of aeroplane design—simplicity and directness of control.

THE Journal of the Royal Society of Arts for October 19 contains an extensive extract from Capt. B. C. Hucks's paper entitled "A Further Three Years' Flying Experience," which was read before the Aeronautical Society last June. This paper is an exceedingly interesting one, coming from such an experienced pilot, and contains many points of scientific interest. Possibly the most interesting of these is the question of flight in a cloud, or when the earth is not visible. Capt. Hucks vividly describes his own experience of such flights, and states that in gusty weather it is exceedingly difficult to keep the machine on a straight path, and that once control is lost it is almost impossible to regain it until out of the cloud. The air-speed indicator and other instruments fitted do not give sufficient indication of the machine's actual motion through space, and Capt. Hucks suggests that some instrument should be fitted which shows a line fixed in space, whatever be the motion of the machine. Such an instrument must apparently depend either on the earth's magnetic field or on gyroscopic action, and the latter seems the more promising. The chief difficulty in designing an instrument of this kind is to render the supporting gimbals sufficiently frictionless, as friction will cause the gyroscope to deviate from its initial position. It seems doubtful if an instrument can be made for continuous use throughout a long flight, but it should be quite possible to design one for intermittent use. The instrument could be set with the gyro axis in some definite direction, such as the vertical, when the machine was flying normally, and then set free when a cloud was encountered. The gyro would maintain its direction sufficiently well for a short time, and could be reset whenever an opportunity afforded. Such an instrument should prove an interesting problem in design for the scientific inventor, and would undoubtedly be a valuable addition to the instrument board on an aeroplane.

WE notice with much regret the announcement of the death on November 4, at forty-five years of age, of Mr. W. Duddell, F.R.S., C.B.E., past-president of the Röntgen Society and of the Institution of Electrical Engineers.

WE regret to announce the death on November 4, at seventy-two years of age, of Sir David C. McVail, professor of clinical medicine in St. Mungo's College, Glasgow, from 1889 to 1906, and author of a number of publications on physiological subjects, especially on diseases of the heart and lungs.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council at the anniversary meeting on November 30:—*President*, Sir J. J. Thomson; *Treasurer*, Sir A. Kempe; *Secretaries*, Prof. A. Schuster and Mr. W. B. Hardy; *Foreign Secretary*, Prof. W. A. Herdman; *Other Members of the Council*, Dr. H. K. Anderson, Sir G. T. Beilby, Prof. G. C. Bourne, Prof. A. R. Cushny, Dr. M. O. Forster, Prof. P. F. Frankland, Dr. J. W. L. Glaisher, Prof. B. Hopkinson, Mr. J. H. Jeans, Prof. W. H. Lang, Major H. G. Lyons, Dr. W. H. R. Rivers, Prof. C. S. Sherrington, Prof. R. J. Strutt, Mr. J. Swinburne, and Prof. W. W. Watts.

AT the annual general meeting of the London Mathematical Society, held on November 1, the president announced the award of the de Morgan medal to Prof. W. H. Young, and stated that, owing to Prof. Young's absence from England, the medal would be given into the charge of the Master of Peterhouse. The following were elected as council and officers for 1917–18:—*President*, Prof. H. M. Macdonald; *Vice-Presidents*, Prof. H. Hilton, Prof. E. W. Hobson, and Sir J. Larmor; *Treasurer*, Dr. A. E. Western; *Secretaries*, Dr T. J. I'A. Bromwich and Mr. G. H. Hardy; *Other Members of the Council*, Prof. W. Burnside, Dr. S. Chapman, Mr. A. L. Dixon, Miss H. P. Hudson, Mr. A. E. Jolliffe, Mr. J. E. Littlewood, Prof. A. E. H. Love, Major P. A. MacMahon, and Prof. J. W. Nicholson.

THERE is a widespread feeling of regret among metallurgists and chemists at the death of Mr. G. T. Holloway, which occurred, after a long and painful illness, on October 24. Mr. Holloway entered the Royal College of Science in 1881, and obtained the associateship in chemistry in 1884. He was assistant-demonstrator in chemistry in the college from 1884 to 1886. He spent some time in Newfoundland, and, returning to England, established a practice as analytical and consulting metallurgist in Chancery Lane. This practice was afterwards transferred to testing works and laboratories in Limehouse, and the business conducted in the form of G. T. Holloway, Ltd. He specialised in some of the less common metals, and few had more knowledge of their occurrence or methods of treatment. Mr. Holloway was a fellow of the Institute of Chemistry and a member of various other societies. He was specially interested in the Institution of Mining and Metallurgy, on the council of which he served for many years. He had considerable experience as an examiner, having acted in this capacity for the University of Birmingham, the Institute of Chemistry, and other bodies. His most recent work, and that perhaps by which in future he will be best known, was the chairmanship of the Canadian Government Commission on nickel. The report of this commission has been issued during the present year, and will long be a standard of reference and a model of what such reports should be. Handicapped from the first by pecuniary circumstances, permanent lameness, and a weak constitution, he had a remarkably clear intellect and a charming personality. He lived to accomplish more than many men who had all the advantages which he lacked. For one who found all physical effort a trial he was wonderfully active and had travelled considerably.

PROF. DASTRE, whose death was announced in NATURE of October 25, was one of the most distinguished pupils of the great physiologist, Claude Bernard. Another pupil, Paul Bert, succeeded Bernard in the chair of physiology at the Sorbonne, and, on Bert's death in 1886, Dastre was elected to the post. Portraits of all three of these noted men are to be seen in the well-known picture by Lhermitte, in which Dastre is represented as taking notes of an experiment shown by Bernard to a number of his friends. Dastre was for many years one of the editors of the *Journal de physiologie et de pathologie générale*, and his kindness in offering to *Physiological Abstracts*, on its foundation, the free use of the excellent abstracts published in his journal was much appreciated by British physiologists. His work in research covers a wide field, both in chemical and in what is sometimes called "experimental" physiology, but that done in conjunction with Prof. Morat on the vasomotor system of nerves is perhaps best known. In this work the existence of vaso-dilator nerves was shown to be more general than had previously been supposed, and much new light was thrown on the functions of the sympathetic nerves. Allied to these problems we find experiments made in order to elucidate the relations between the nervous regulating mechanism of the heart and the functions of the muscular structure itself. A number of papers was published relating to the digestion and metabolism of fats and sugars. The part played by the bile in the digestion and absorption of fats was pointed out. Of other important work, the rapid accommodation of the vascular system to the injection of large amounts of saline solutions and the method of mixed anæsthesia with morphine and chloroform may be mentioned. Contrary to general opinion at the time, Dastre showed that expired air does not contain any toxic substance. He also devoted some attention to the more morphological problems of embryology.

MR. WORTHINGTON G. SMITH, whose death was announced in NATURE of November 1, was a man with varied interests and a broad outlook. A good townsman (he was the first Freeman of Dunstable to be elected since the foundation of the borough by Henry I.), a keen politician, originally by profession an architect, a draughtsman and engraver, an antiquary of note, he was also among the first botanical artists in black and white, and an admitted authority on the larger British fungi. At the age of twenty-three he gave up the practice of architecture in favour of book illustration, and for many years drew architectural subjects for the *Builder*. Plant-forms, and especially the larger fungi, had attracted him, and in 1867 he drew, lithographed, and described two large coloured sheets of "Edible and Poisonous Mushrooms" for Mr. Hardwicke, the publisher. In 1869 he was discovered by Dr. Maxwell Masters, and from then onwards for nearly half a century supplied the drawings of new or noteworthy plants with which readers of the *Gardeners' Chronicle* are familiar. To his training as an architect we doubtless owe the sharp, clear accuracy of his drawings and his careful attention to detail. In 1884 was published his "Diseases of Field and Garden Crops," chiefly such as are caused by fungi, written and illustrated by himself. A beautiful memorial of his work on the larger fungi is exhibited in the botanical gallery at the Natural History Museum in the form of more than a hundred large sheets of coloured drawings of our British species. His "Synopsis of British Basidiomycetes," published by the trustees of the British Museum in 1908, is descriptive of these drawings. His "Guide to Sowerby's Models of British Fungi" (British Museum, 1891) is a capital little handbook on the larger species. Many of his drawings have been acquired by the museum, including a fine series illustrating the larger British fungi. Worthington Smith was a fellow of the Linnean and various other societies, and in 1903 he was elected president of the British Mycological Society. The Royal Horticultural Society showed its appreciation of his work by several awards, including the Knightian gold medal in 1895 for his researches into the life-history of the potato-disease fungus. An appreciation of Worthington Smith's work, with an excellent portrait, forms the leading article in the issue of the *Gardeners' Chronicle* for November 3.

THE trustees of the British Museum have issued three more of the useful pamphlets (Nos. 4, 5, and 6) of the "Natural History Economic Series." These describe mosquitoes, the bed-bug, and species of Arachnida and Myriopoda injurious to man, and are written respectively by Mr. F. W. Edwards, Mr. Bruce F. Cummings, and Mr. Stanley Hirst. The outward form, life-histories, and habits of the various creatures are clearly described, with good figures and some practical advice for the destruction of pests. Most readers of

the last-named pamphlet will be surprised to learn of the number of species of centipedes and millipedes which are recorded as accidental inhabitants of the human intestine.

THE extreme severity of the winter of 1916–17 levied a heavy toll on the birds throughout the British Islands, and it seems to have borne no less heavily on our native flora. Not even Ireland escaped. Mr. C. B. Moffat has already placed on record a number of observations as regards the birds of Ireland, and he now follows these up with a similar survey of the havoc wrought among the native plants of Co. Wexford. In the *Irish Naturalist* for October he tells us that at least five species of plants have been so reduced that it seems doubtful whether they will recover their former plenty. These are the weld (*Reseda luteola*), pale-flowered flax (*Linum angustifolium*), fleabane (*Pulicaria dysenterica*), greater broomrape (*Orobanche major*), and the lesser broomrape (*O. minor*).

A VALUABLE and illuminating summary of what is known of the habits and migrations of Chimæræ off the Scandinavian coasts and the northern waters of our own shores is given by Prof. D'Arcy Thompson in the *Scottish Naturalist* for October. Though his survey includes two species, *Chimaera monstrosa* and *C. mirabilis*, his remarks are mainly concerned with the former species. Hitherto it has been generally supposed that this spawned only in deep water, but it is now shown to spawn off the Norwegian coasts in shallow water in winter-time, and to migrate to the depths during spring and summer. Prof. Thompson is disposed to regard these migrations as governed by temperature rather than by the search for food; for the species shows a partiality for cold or cool water, and while in general it finds this optimum temperature in the deeper waters outside the continental shelf, so also it finds it in winter, but then only in the shallow coastal waters of Norway. Many gaps, however, in our knowledge of these migrations yet remain to be filled; for it is pointed out that from its occurrence more or less all the year round off the south-west of Ireland we are precluded from supposing that the various localities where the species has been found lie in one continuous and regular route of migration. We cannot correlate what we know of it in Norway, in the northern North Sea, and off the Hebrides with what we know of it in the Bay of Biscay, the south-west of Ireland, and the Faröe Channel. It seems, on the whole, probable that in its more southern and more western habitats the habits of the species are different from those in the north; that it is here confined to deeper waters, but that it tends to resort periodically to still deeper parts of the ocean, where it chiefly spawns.

DR. J. D. F. GILCHRIST has sent to us a note on luminosity in South African earthworms. He refers to the Rev. Hilderic Friend's interesting letter in NATURE (vol. xlvii., 1893, p. 462) for earlier records, and states that other cases have been noticed since then. Opinions are, however, divided as to the source of the phosphorescence, the latest suggestion being that it is due to luminous fungi. During a dark and damp evening Dr. Gilchrist observed bright patches on the ground in a pinewood on the slopes of Table Mountain. These were traced to earthworms, specimens of which when dug up discharged a viscid luminous fluid from the mouth, and usually from the anus as well. Phosphorescent patches seen on the body were attributed to portions of this discharge, perhaps scattered by the movements of the worm; but they may have been due to something given out from an injury to the body. The luminous discharge contained numerous nucleated, granular cells, some of which showed active movements, and resembled Gregarines. Dr. Gilchrist thinks he has found sporoblasts and spores which confirm this view of their nature. The proof that the cells were luminous was obtained by examining them under the microscope, in a dark room, by means of their own light. The fluid containing them, when dried at 60° C., recovered its luminosity when breathed on or otherwise moistened. A useful survey of what is known in regard to the production of light by animals will be found in papers by Prof. U. Dahlgren, referred to in recent volumes of NATURE (vol. xcvii., p. 146; vol. xcix., pp. 191, 430).

WITH the continued improvement of cytological methods our knowledge of the minute details of the growth and maturation of the germ-cells is constantly increasing. At first attention was focussed upon the remarkable changes undergone by the nucleus and the mechanism of nuclear division during these processes, with results which are now well known to every serious student. More recently a large amount of laborious research has been devoted to the behaviour of the cytoplasm and its various inclusions—mitochondria, macromitosomes, micromitosomes, acroblasts and acrosomes, to mention only some of the numerous terms employed by recent investigators. The story of the behaviour of these enigmatical bodies is scarcely less remarkable than that of the behaviour of the nucleus, and may well be regarded as affording some justification for the view that the cytoplasm plays an important part in the transmission of inherited characters. To those who have not followed the gradual elaboration of this story by various writers a memoir in the current number of the *Quarterly Journal of Microscopical Science* (vol. lxii., part 3), by Mr. J. Bronté Gatenby, will come almost as a revelation. It deals with the cytoplasmic inclusions of the germ-cells in Lepidoptera, a subject which is far too complex to be adequately summarised in this place. This memoir is a veritable triumph of microscopical technique, and the numerous figures by which it is illustrated are remarkably beautiful and convincing. As a clear exposition of the latest views on the subject, as well as for the sake of the new results which it deals with, it should meet with a hearty welcome from all biological students.

AGRICULTURAL problems are largely represented in recent numbers of the *Atti dei Lincei*. Thus Prof. Alfonso Splendore (vol. xxv., 2, p. 12) describes researches on the bacterial parasites of the field mouse (Patymys) with a view to their application to the extermination of these pests. The parasitic fungi which give rise to the so-called "ink disease" in chestnut trees are discussed by Dr. L. Petri in the same number. Dr. Mario Topi (vol. xxvi., 1, p. 4) gives statistics showing the effect of arseniate of lead and tobacco in destroying the larvæ of the Tineæ, which attack vines. Dr. Benjamino Peyronel (vol. xxvi., p. 9) describes a potato disease new to Italy, due to the fungus *Spondylocladium atrovirens*, which was first discovered in Vienna on the tubers of potatoes in 1872, and described by Johnson as occurring in Ireland in 1903. It would appear, however, that though this fungus is difficult to destroy chemically, its effects on the tubers are mainly superficial. In a later number (vol. xxvi., p. 11) Prof. Vittorio Peglion discusses the Peronospora of the hemp (*P. cannabina*), which is referred to a new subgenus, and of which the life-history is still in doubt. The same writer, in a later number (vol. xxvi., 1, p. 12) discusses the gummy fungus which is at present threatening the apricot trees in Emilia, and is

referred to the genus Sclerotinia. It appears to attack the flower, fruit, and all parts of the apricot.

THE October number of the *Journal of the Board of Agriculture* contains several articles of interest relating to seeds. A summary is given of the more general measures taken by the Governments of British Dominions and of foreign countries with the object of eradicating weeds and providing pure seeds. The summary deals mainly with measures for the prevention of the importation of weed seeds, restrictions on the internal sale of seeds, and control stations for analyses of seeds. It is of interest to note that the reproach that England is almost the only important country having no adequate seed regulations and no official seed-testing station is about to be removed, as it is announced that an official seed-testing station for England and Wales is being organised at the Food Production Department. The station will be under the direction of Mr. R. G. Stapledon, adviser in agricultural botany to University College, Aberystwyth. Other articles in the same number deal with seed production in Canada and economy in the use of vegetable seeds. The latter is published separately as Food Production Leaflet No. 8, copies of which may be obtained gratis on application to the Board.

THE disadvantages of the various thermometric scales in use is raised by Mr. A. McAdie, director of the Blue Hill Observatory, in a paper in the *Geographical Review* for September (vol. iv., No. 3) entitled "The Passing of the Fahrenheit Scale." The growing study of the upper air and the structure of the atmosphere has led, at least in America, to a tendency to use the Absolute scale, instead of the Centigrade or Fahrenheit. The chief advantage of the Fahrenheit over the Centigrade and Absolute scales is the smaller divisions, which give the readings more definiteness. In order to combine this feature with the advantages of the Absolute scale Mr. McAdie proposes a new scale, for which he has found no name. Zero is the same as in the Absolute scale ($-273\cdot02^\circ$ C.), and freezing point is 1000. The divisions are considerably smaller than on the Fahrenheit scale, there are no minus signs, and there is a fundamental difference between readings above and below freezing point, to cite only some of the merits which the author claims for his new scale.

THE weakest part of school geography as a rule lies in the teaching of climate. Broad generalisations based on the general laws of physics, but fallacious in their application, mar the treatment of the subject in almost all school books. We welcome, therefore, an article by Mr. B. C. Wallis on the monsoon in the *School World* for October (abridged from an article written for *Indian Education*). In this article Mr. Wallis sets out the facts of the monsoon and the incidence of the monsoon rains, wisely refraining from any attempt to explain the phenomena. He gives five rainfall areas for India, each marked by rainfall intensity at one or other period of the year, and indicates the major portions of each without vainly attempting to find precise boundaries. The article, which we notice is not copyrighted, should be most useful to teachers and students in its clear presentment of facts and its absence of any striving for false simplicity. Incidentally, it is hoped that it will help to kill the long-established myth of the monsoon as gigantic land and sea breezes based on the heating and cooling of Central Asia. This fallacy is still current in school geography, despite repeated attempts by the late Prof. Herbertson to dispel it in his many text-books.

A REPORT of the Fernley Observatory, Southport, with the meteorological results for the year 1916, under the directorship of Mr. Joseph Baxendell, meteorologist to the corporation, has been issued by the county borough of Southport. The observations are carried out with the greatest care, and the instruments and their positions are such as to render the results of the highest possible value. Close contact has been kept with the Meteorological Office, and detailed observations are supplied for the various official reports. In the statistical tables the new units of measurement are given, as well as the old. A new table is given which shows the amount, duration, and intensity of rainfall for each eight points of wind direction. For the year 1916 the largest amount of rain fell with south-west and south winds, the measurement being six times as great as with a north wind. The duration of rainfall was greatest with south-west, west, and south-east winds. A "discontinuity" in the amount of rainfall for the several months of the year is shown by the series of observations. During the twenty-six years from 1871 the average rainfall for July is given as 3·64 in., whilst during the subsequent nineteen years it was only 2·25 in.; September in the earlier series has 3·46 in., and later only 2·38 in. The later series of observations shows that all the months July to November have become drier, whilst six out of seven of the remaining months, December to June, have actually become wetter. Older records in the district show the change in the character of the weather to be subject to periodic variation.

RECENT writers on the subject of optical glass have shown a tendency to assign the whole of the credit for the introduction of the newer materials like baryta, magnesia, and the phosphates into glass-making to Abbe and Schott, of Jena. In an editorial note in the *British Journal of Photography* for October 19 it is pointed out that baryta has been used in glass-making since 1830, and that both Fraunhofer and Faraday made boro-silicate glass, Schroeder made magnesia glass, Maïs used zinc oxide, both Harcourt and Stokes made phosphate glasses, while French glass-makers have used thallium and fluorides for some time. The journal claims that some of the credit for the introduction of the newer materials now used in glass-making should be given to these pioneer workers.

WHAT is called the "uniform movement" of flame occurs when an inflammable mixture of gases is ignited at the open end of a horizontal tube closed at the other end. Messrs. W. A. Haward and S. G. Sastry (Journal of the Chemical Society, September, 1917) have determined the speeds of this uniform movement in mixtures of acetylene and air. When these speeds (obtained with a glass tube 12 mm. in diameter) are plotted against the percentages of acetylene, a curve is obtained which rises rapidly from 3 per cent. of acetylene to a maximum at 8–10 per cent., and then falls more slowly to 20 per cent. of acetylene. Mixtures richer than the last in acetylene deposit soot when burnt, and the propagation of flame is slow. There is a gradual flattening of the curve towards the limits of inflammability, as in other inflammable mixtures. Previous experiments with mixtures of acetylene and air, by Le Chatelier, led him to depict the results by a curve consisting of three straight lines, the first to a maximum at 10 per cent. of acetylene, the second falling from this maximum, and the third (from 20 per cent. acetylene to the limit of inflammability) corresponding with combustion with a fuliginous flame. As stated, the authors obtained a smooth curve not consisting of straight lines.

OUR ASTRONOMICAL COLUMN.

THE METEORIC SHOWER OF OCTOBER.—Between October 13 and 28 last, inclusive, observations were obtained at Bristol on fourteen nights, and 197 meteors were seen in twenty-three hours of watching, chiefly before sunrise. Fifty-six of the meteors recorded belonged to one or other of the two principal displays of the October epoch near ξ Geminorum ($98^\circ+14^\circ$, thirty-two meteors) and ν Orionis ($92^\circ+15^\circ$, twenty-four meteors). The former was also the stronger shower in 1916, and in some previous years, though in 1877 and 1887 the Orionids formed by far the richer display. Of the minor showers the most active were at $42^\circ+20^\circ$ in Aries, and $163^\circ+59^\circ$ near β Ursæ Majoris.

Two fireballs have been recently observed with sufficient completeness to allow their real paths to be ascertained, viz.:-

(1) October 18, 2h. 15m. a.m., radiant $90^\circ+16^\circ$ height seventy-two to forty-seven miles over Lincolnshire.

(2) October 23, 7h. 33m. p.m., radiant $42^\circ+20^\circ$, height sixty-five to thirty-three miles from over North Sea to west of Scarborough.

GALACTIC CONDENSATION OF STARS.—Expressing galactic condensation as the ratio of the number of stars per unit area at 5° galactic latitude to the number at 80°, Kapteyn found values ranging from 2·8 at the ninth magnitude to 27·7 at the sixteenth. The relatively large value for the very faint stars did not appear in Chapman and Melotte's discussion of the Franklin-Adams plates, but it has since been substantially confirmed by work with the 60-in. reflector at Mt. Wilson. A further investigation of this question has been based by Dr. F. H. Seares on the counts of nearly 600,000 stars which have been collected by Prof. Turner (*Astrophysical Journal*, vol. xlvi., p. 117). The galactic condensation deduced from these is in close agreement with the results obtained by Kapteyn. The variations of density with right ascension, however, are not greater than the uncertainties affecting the results, so that no evidence was found for the spiral of obscuring matter derived by Prof. Turner from the same data. It would appear that Prof. Turner did not make sufficient allowance for the high galactic concentration of the faint stars.

THE VARIABILITY OF B.D. $+56\cdot547^\circ$.—The variability of this star was first detected by Mr. J. Van der Bilt, and, at his suggestion, the photographic magnitudes have been determined by Messrs. Martin and Plummer from numerous plates taken at Dunsink in connection with a previous study of three other variables in the region of χ Persei (Monthly Notices, R.A.S., vol. lxxvii., p. 651). The star has turned out to be of rather special interest, inasmuch as it shows an unexpected periodicity. The interval from maximum to maximum is about 704 days, and the range of variation is from magnitude 9·8 to 10·3. The other three stars resemble it in having a high colour-index, and are therefore probably in a similar physical condition, but these vary in the irregular way which is characteristic of nearly all variables which are very red.

THE "JOURNAL DES OBSERVATEURS."—The index to vol. i. and the first number of vol. ii. of this publication have been received. The journal is especially noteworthy for communications relating to observations and ephemerides of minor planets and comets. The current issue gives ephemerides of the planets (108) Hecuba and (394) Arduina, together with observations of numerous planets made at Nice, and of Mellish's comet (1917a) made at the Cape Observatory. The editor is M. Henry Bourget, director of the Observatory of Marseilles.

MILITARY AIRCRAFT AND THEIR ARMAMENT.

AN article of considerable interest, under the title of "La Technique Allemande de l'Armement Aérien," appears in *La Nature* for October 6 by Jean-Abel Lefranc. The author traces out the development of German aerial warfare, with particular reference to the armament of military aircraft. Victory in the air, he says, depends on two sets of factors—tactical and technical. Under the former head he places favourable time of attack, good position, powerful formation; under the latter, armament, speed, flexibility of control, and altitude. To secure a good tactical position a machine must possess good technical factors; for instance, good armament is useless unless a machine is fast enough to be able to challenge the enemy to battle. Nevertheless, the pilot counts for a great deal, and the "Farmans" of 1915 beat the "Aviatiks," although the latter were faster, better armed, and more flexible. M. Lefranc remarks that the relative importance of the technical elements depends on the purpose of the machine; for a battleplane, he places them in the order speed, flexibility, armament, and altitude. The last attribute might be omitted, since a fast machine is always a good climber unless the landing speed is abnormally high. For slow and heavy machines designed for bombing, a powerful defensive armament is most essential. For night raiders radius of action, bomb capacity, and facility of landing are more important than armament. The speed of both French and German fighters varies from 100 to 120 miles per hour. These speeds could be higher but for the necessity of a reasonable landing speed and a good climbing rate. The heavy bombing machines fly at speeds from eighty to ninety-five miles per hour. Flexibility has now developed almost without limit.

M. Lefranc divides the period since the war commenced into two parts. In the early days the importance of the mastery of the air had not been fully appreciated, and aerial combats were rare. The chief use of aeroplanes was to obtain information as to the enemy's position. The French machines, being of the "pusher" type, mounted the gun in front, and had a large "dead angle" behind, which was out of the range of fire of the gun. The German machines were mostly tractors and mounted their guns behind the main planes. They had the decided advantage that their "dead angle" was under the surveillance of the pilot. Early aerial fights were generally ineffective, and resulted in a few bullet-holes in the wings, mainly owing to difficulties of aim and the small quantity of ammunition carried.

The later period of the war has produced three main types. The first type resulted from the design of a gun firing through the propeller and under the control of the pilot. Firing through the propeller may be achieved by fitting metal shields to the blades to prevent destruction by the bullets, but is better attained by automatic timing of the firing to miss the blades, as this need not interfere with the design of an efficient propeller. The second type, a heavier machine, mounts a rear gun on a turntable, in addition to that firing ahead through the propeller. In the third type, of which the 1916–17 Gotha is an example, twin propellers are used, and both forward and rear guns have a wide angle of fire. There is also a third gun firing below the fuselage, as a defence against attack from below—a very vulnerable point in the older machines. This third type has no "dead angle," but can bring one or other of its guns to bear on any point. One of the greatest difficulties of effective gun practice in the air is that due to error of aim resulting from the relative movement of the two machines. Various

attempts to correct the aim by automatic sights have been made, but the most effective measure is to fire as many rounds as possible during the combat; hence the frequent duplication of a forward fixed gun.

M. Lefranc concludes his article with a brief description of the types of bullet used by the Germans. He mentions four types: the ordinary bullet, the perforating bullet for destroying the engines and metal parts of a machine, the incendiary bullet, and the explosive bullet. The article is liberally illustrated with sketches and diagrams, and is well worthy of perusal. Any attempt to trace developments further than M. Lefranc has done would doubtless be censored; indeed, some ten lines of the article in question have been censored as it is. We have, therefore, contented ourselves with a brief *résumé* of the most important points of the article, as they will doubtless be of interest to those who follow the progress of the scientific development of aircraft.

REPORTS ON CLIMATES.

AN interesting memoir on the climate of Bagdad ("Sul Clima di Bagdad"), by Prof. Filippo Eredia, appears in a recent issue of the *Bollettino della Reale Società Geografica Italiana*, under the auspices of which a mission was dispatched in 1908, led by Dr. A. Lanzani. Prof. Eredia summarises the more salient features of this expedition's work, and further utilises information given in various papers by Eliot, Hann, and Gilbert Walker. Bagdad is in lat. 33° 19′ N., long. 44° 26′ E., the height of the cistern of the barometer above sea-level being 127 ft. The mean barometric pressure at 32° F. sea-level and lat. 45° is 29·893 in., being highest, 30·149 in., in January, and lowest, 29·543 in., in July, a variation in the monthly means of 0·60 in. The mean annual temperature is 73·0° F., ranging from 94·5° in July and August to 48·9° in January. The mean of the daily maxima is 86·0°, the mean monthly values ranging from 109·9° in August to 59·5° in January. The mean of the night minima is 60·1°, highest in July, 79·5°, and lowest in January, 38·1°. The highest temperature recorded was 122°, and frost is not uncommon from November to February. The mean daily range of temperature varies from 33° in August and September to 20° in December. The relative humidity is 58, rising to 80 per cent. of saturation in December and January, and falling to 38 per cent. in June. The mean cloud amount (overcast sky=100) is only 16, the extremes being 29 in March and 1 in July. Various authorities place the annual rainfall between 6·94 in. and 9·04 in., practically all of which falls between November and April. June, July, and September are rainless, but slight showers have fallen in May, August, and October.

A useful paper appears in the *Bollettino d'Informazione* (Anno iv., N. 7–8–9) of the Italian Ministry for the Colonies, by Prof. Eredia, on the climate of Derna, an important commercial centre of Bengasi, situated in lat. 32° 45′ N., long. 22° 40′ E. Some fragmentary data collected by previous writers is first summarised, but the greater part of the paper is taken up with a discussion of observations extending from March, 1913, to December, 1915, made with a complete instrumental installation. The observations made at 9 a.m., 3 p.m., and 9 p.m. are collected in ten-day periods for each of the three hours. The mean annual temperature is 68° F., of August, the warmest month, 78·3°, and of January, the coldest month, 57·4°. The extremes noted have been 112° and 40°. The mean annual barometric pressure is exactly 30 in., showing a range of 0·17 in. between December (the month of highest pressure) and July (the month of lowest pressure). The annual rainfall is 7·94 in., of which 86 per cent. falls between November and February. There are fifty-one days in the year with precipitation, July and August being rainless. In spite of the small rainfall heavy downpours are occasionally observed. Thus 3·13 in. have fallen in two days, and three daily falls exceeding an inch have occurred. The prevailing wind, except in December and January, is north-west, one result of this being the remarkable steadiness of the relative humidity, which in no month differs appreciably from the annual mean of 62. The mean amount of cloud varies from 9 per cent. in July to 57 per cent. in February.

Prof. Eredia discusses in vol. xxvi. of the *Rendiconte della R. Accademia dei Lincei* the monthly variations of barometric pressure at twelve places in Italy, based on data for the thirty-five years 1881–1915. The maximum is in January and the minimum in April at all stations. At Pesaro, Florence, Rome, and Lecce there is a well-marked secondary minimum in July. The variation in the monthly means diminishes appreciably with latitude, the amplitude between the months of highest and lowest pressure being 0·07 in. less on the southern coasts than at northern inland stations. Prof. Eredia also contributes a paper, "Le Brine in Italia," to a recent issue of the *Bollettino Bimensuale della Società Meteor. Ital.*, in which he summarises the results of an investigation into the frequency of hoar frost in Italy. The mean monthly number of cases is given for fifty stations well distributed over the country for the five months, November to March, during the twenty years ending 1915. The greatest number of cases is in January, closely followed by December. Pavia, in Lombardy, has an average of forty-one cases during the five months under consideration, whilst at Naples the mean frequency is only 0·4. In most districts coastal stations have a relatively small number of cases as compared with inland stations contiguous. The distribution of pressure and also local conditions favourable to the production of hoar frost are discussed in considerable detail. The insertion of a small map showing the position of the stations utilised would add much to the interest of Prof. Eredia's valuable investigations into various phases of Italian climatology.

R. C. M.

EVOLUTION OF THE PRIMATES.

DR. W. K. GREGORY, of the American Museum of Natural History, New York, has contributed to the Bulletin of that institution a series of studies on the "Evolution of the Primates." In part i. he reviews the theory of cusp-formation which was first formulated by Cope and afterwards elaborated and perfected by Osborn, and contends that all later discoveries have justified their supposition that the upper molars of primates (and also of all typical placental mammals) are modifications of a common tritubercular type, while the lower molars are modifications of a "tuberculo-sectorial" form. In his opinion the similarity of the molar type in all forms of man and anthropoid, both living and extinct, is a matter beyond dispute.

In part ii. Dr. Gregory discusses the phylogeny of the known anthropoid and human types. He regards the chimpanzee and gorilla as man's nearest allies, and, on the present evidence, thinks the common stock from which all three arose may have been in existence during the Miocene period. His review of the dental characters of extinct anthropoids is most welcome. He cannot agree that the genus Sivapithecus, recently described by Dr. G. E. Pilgrim, of the Geological Survey of India, stands in the direct line of human.

ancestry. He supports his colleague, Dr. W. D. Matthew—in opposition to the view generally held in this country—in regarding the lower jaw of Eoanthropus as that of a Piltdown chimpanzee associated by a curious chance with the Piltdown man in a pocket of gravel. We look forward to the appearance of parts iii. and iv. of Dr. Gregory's studies, in which he proposes to review the phylogenies of the catarrhine, or Old World, monkeys, and platyrrhine, or New World, monkeys and Lemuroids.

HEREDITARY CHARACTERS IN RELATION TO EVOLUTION.

PROF H. S. JENNINGS, of the Johns Hopkins University, delivered a lecture on March 15 before the Washington Academy of Sciences on "Observed Changes in Hereditary Characters in Relation to Evolution." This lecture, published in the Journal of that Academy (vol. vii., No. 10), consists of a discussion on the factors of evolution of such great interest that we have decided to print an abridgment so that readers of NATURE may have the opportunity of studying and appreciating his arguments as set forth in his own words. The older school of biologists in this country will doubtless welcome Prof. Jennings's brilliant and ingenious interpretation of the recent work of American zoologists on genetics, so as to support the Darwinian interpretation of the evolutionary process. Prof. Jennings's criticism of Mr. Bateson's British Association address (1914) leaves the reader in doubt whether he has appreciated the view that the "loss and disintegration" in the germ-plasm are conceived by Bateson as the shedding of successive inhibitory factors the withdrawal of which leaves the hypothetical fundamental germ-complex free to produce an increasingly complex result in the developing organism.

The problem of the method of evolution is one which the biologist finds it impossible to leave alone. Can we bring the facts which experimental work has brought out into relation with the method of evolution?

What we may call the first phase of the modern experimental study of variation is that which culminated in the establishment of the fact that most of the heritable differences observed between closely related organisms—between the members of a given species, for example—are not *variations* in the sense of alterations; are not active *changes* in constitution, but are permanent diversities; they are static, not dynamic. This discovery was made long ago by the Frenchman Jordan; but, as in the case of Mendelism, science ignored it and pursued cheerfully its false path until the facts were rediscovered in recent years. All thorough work has led directly to this result: that any species or kind of organism is made up of a very great number of diverse stocks, differing from each other in minute particulars, but the diversities inherited from generation to generation. This result has in recent years dominated all work on the occurrence of variations; on the effects of selection; on the method of evolution. The condition is particularly striking in organisms reproducing from a single parent, so that there is no mixing of stocks; I found it in a high degree in organisms of this sort which I studied. Thus the infusorian Paramecium I found to consist of a large number of such heritably diverse stocks, each stock showing within itself many variations that are not heritable.[1] *Difflugia corona* shows the same condition in a marked degree.[2] A host of workers have found similar conditions in all sorts of organisms. It led to the idea of the genotype (Johannsen), as the permanent germinal constitution of any given individual; it supported powerfully the conception of Mendelism as merely the working out of recombinations of mosaic-like parts of these permanent genotypes. The whole conception is in its essential nature static; alteration does not fit into the scheme.

This discovery seemed to explain fully all the observed effects of selection within a species; but gave them a significance quite the reverse of what they had been supposed to have. It seemed to account for practically all the supposed variations that had been observed; they were not variations at all, in the sense of steps in evolution; they were mere instances of the static condition of diversity that everywhere prevails. Jordan, the devout original discoverer of this condition of affairs, maintained that it showed that organisms do not really vary; that there is no such process as evolution; and, indeed, this seems to be the direct logical conclusion to be drawn.

Now, this multiplicity of diverse stocks really represents the actual condition of affairs, *so far as it goes*. Persons who are interested in maintaining that evolution *is* occurring, that selection *is* effective, and the like, make a very great mistake in denying the existence of the condition of diversity portrayed by the genotypists. What they must do is to accept that condition as a foundation, then show that it is not final; that it does not proceed to the end; that the diverse existing stocks, while heritably different as the genotypists maintain, may also change and differentiate, in ways not yet detected by their discoverers.

But, of course, most of the adherents of the "orthodox genotype theory" do not maintain, with their first representative Jordan, that no changes occur. Typically, they admit that *mutations* occur; that the genotype may at rare intervals transform, as a given chemical compound may transform into another and diverse compound. We all know the typical instances: the transforming mutations of Œnothera; the bud variations that show in a sudden change of colour or form in plants; the dropping out of definite Mendelian units in Drosophila and elsewhere; the transformation of particular Mendelian units into some other condition.

So much, then, may serve as an outline of a prevailing theory; organisms forming a multitude of diverse strains with diverse genotypes; the genotype a mosaic of parts that are recombined in Mendelian inheritance; selection a mere process of isolating and recombining what already exists; large changes occurring at rare intervals, through the dropping of bits of the mosaic, or through their complete chemical transformation; evolution by saltations.

Certain serious difficulties appear in this view of the matter; I shall mention merely two of them, for their practical results. One is the very existence of the minutely differing strains, which forms one of the main foundations for the genotype theory. How have these arisen? Not by large steps, not by saltations, for the differences between the strains go down to the very limits of detectibility. On the saltation theory, Jordan's view that these things were created separate at the beginning seems the only solution.

Secondly, to many minds there appears to be an equally great difficulty in the origin by saltation of complex adaptive structures, such as the eye. I shall not analyse this difficulty, but merely point to it and to the first one mentioned, as having had the practical effect of keeping many investigators persistently at work looking for something besides saltations as a basis for evolution; looking for hereditary changes that would permit a continuity in transformation.

Where reproduction is from a single parent we meet the problem of inheritance and variation in its

[1] Jennings, 1908–11. (See Bibliography.)
[2] Jennings, 1916. (See Bibliography.)

simplest form; for there is nothing which complicates genetic problems so enormously as does the continual mixing of diverse stocks in biparental inheritance. In uniparental reproduction we have but one genotype to deal with; we can be certain that no hereditary characters are introduced from outside that genotype.

To hope for results on the problem in which we are interested, we must resolve to carry on a sort of second degree research, as it were. We must take a single stock—choosing an organism that is most favourable for such work—then proceed to a most extensive and intensive study of heredity, of variation, and of the effects of selection for long periods within such a stock.

Such an organism, most favourable from all points of view, I found in the rhizopod *Difflugia corona*. It has numerous distinctive characters, all congenital, all inherited in a high degree, yet varying from parent to offspring also; none of these characters changed by growth or environmental action during the life of the individual.

Long-continued work showed that a single strain of this animal, all derived by fission from a single parent, does differentiate gradually, with the passage of generations, into many hereditarily diverse strains. The important facts about the hereditary variations and their appearance are the following:—

(1) Hereditary variations arose in some few cases by rather large steps or "saltations."

(2) But the immense majority of the hereditary variations were minute gradations. Variation is as continuous as can be detected.

(3) Hereditary variation occurred in many different ways, in many diverse characters. There was no single line of variation followed exclusively, or in the overwhelming majority of cases.

(4) It gave rise to many diverse combinations of characters: large animals with long spines; small animals with long spines; large animals with short spines; small animals with short spines; and so on. Any set of characters might vary independently of the rest.

(5) The hereditary variations which arose were of just such a nature as to produce from a single strain the hereditarily different strains that are found in nature.[3]

I judge that if the intermediate strains were killed, the two most diverse strains found in Nature might well be classed as different species, although the question of what a species is must be left to the judgment or fancy of the individual.

How do these results compare with those found by other men? If we take a general survey, we find the following main classes of cases:—

(1) First, we have the mutations of Œnothera and its relatives: large transformations occurring suddenly.

(2) Secondly, we have a large miscellaneous collection of mutations observed in various classes of organisms: "bud variations," dropping out of unit factors, and the like—all definite saltations, but not genetically fully analysed.

(3) In Drosophila as studied by Morgan and his associates, we have the largest and most fully analysed body of facts which we possess with respect to changes in hereditary character in any organism. The changes here are pictured as typical saltations; but of these I shall speak further.

(4) In palæontology, as the results are presented in recent papers by Osborn,[4] the evidence is for evolution by minute, continuous variations which follow a single definite trend.

(5) Finally, we have the work in biparental inheritance from Castle and his associates[5]; this gives evidence for continuous variation, not following a single necessary trend, but guided by external selection.

Furthermore, we discover in our survey that there are at least two well-marked controversies in flame at the present time:—

First, we have the general controversy between, on one hand, those who are mutationists and adherents of the strict genotype view; on the other, those who, like Castle, believe that we observe continuous hereditary variations in the progress of biparental reproduction. The mutationists attempt to show that the apparent gradual modification of characters observed in breeding is in reality a mere working out of Mendelian recombinations.

Secondly, we have a somewhat less lively controversy between the genotypic mutationists and the palæontological upholders of evolution by continuous variation.

Now let us look briefly into the points at issue in the controversy between the "genotypic mutationists" and the upholders of gradual change during biparental inheritance.

Castle finds that in rats he can, by selection, gradually increase or decrease the amount of colour in the coat, passing by continuous stages from one extreme to the other. As to this, he holds two main points:—

(1) The change is an actual change in the hereditary characteristic of the stock; not a mere result of the recombination of Mendelian factors. This is the general and fundamental point at issue.

(2) More specifically, he holds it to be an actual change in a single-unit factor; this single factor changes its grade in a continuous and quantitative manner.

On the other side, the critics of these views maintain that the changes shown are not actual alterations in the hereditary constitution at all, but are mere results of the recombinations of Mendelian factors. And specifically, they find a complete explanation of such results as those of Castle in the hypothesis of *multiple modifying factors*. There is conceived to be a single "main factor" which determines whether the "hooded pattern" shall, or shall not, be present. In addition to this there are a considerable number of "modifying factors" which, when the "hooded pattern" is present, increase or decrease the extent of pigmentation. When many of the positive factors of this sort are present, the rat's coat has much pigment; when fewer are present the extent of pigment is less, and so on. The process of changing the extent of pigmentation by selection consists, according to this view, merely in making diverse combinations of these factors, by proper crosses.

This same explanation is applied to a great variety of cases. Castle had carried the war into the enemy's country by predicting (or at least suggesting) that the so-called unit characters in Drosophila would be found to be modifiable through selection.[6] Later research by MacDowell (1915), Zeleny and Mattoon (1915), Reeves (1916), Morgan (1917), and Sturtevant (1917) actually verified this prediction; it has indeed been found that the Drosophila mutations can be modified by selection. Again, the mutationists counter the blow with their explanation of multiple modifying factors, which are segregated in the process of selection; and they give some real evidence that such is actually the case. What I am going to do is to abandon the ground that Castle would defend, proceed directly into the territory of the enemy, accept the conditions met there, then see where we come out in relation to the nature of variation, the effects of selection, and the method of evolution.

In no other organism have heritable variations been

[3] The full account of this work is given in Jennings, 1916. (See Bibliography.)

[4] Osborn, 1912, 1915, 1916. (See Bibliography.)

[5] Castle, 1915 *a*, 1916, 1916 *a*, 1916 *b*, 1917; Castle and Phillips, 1914, etc. (See Bibliography.)

[6] Castle, 1915, p. 39. (See Bibliography.)

studied so thoroughly as in Drosophila, and no other body of men have been more thoroughgoing upholders of mutationism and of the multiple factor explanation of the effects of selection than the students of Drosophila—Morgan and the others. We may therefore turn to the evidence from Drosophila with confidence that it will be presented with fairness to the mutationist point of view. We shall first ask (1) what we learn from the work on Drosophila as to the possibility of finding finely graded variations in a single unit character. Next we shall inquire (2) as to the relation of the assumed modifying factors to changes in hereditary constitution; to the nature of the effects of selection.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. F. C. Bartlett and Mr. G. M. Bennett have been elected to fellowships at St. John's College. Mr. Bartlett, who was placed in the first class in the Moral Sciences Tripos, 1914, is assistant in experimental psychology, and is acting as interim director of the psychological laboratory during the absence of the director. Mr. Bennett was placed in the first class of the Natural Sciences Tripos, both in Part I. in 1914 and in Part II. (chemistry) in 1915.

LEEDS.—The University has received with great regret the resignation by Prof. A. S. Leyton of the chair of pathology and bacteriology in the University. In accepting this resignation, the University Council has taken the opportunity of recording its high appreciation of the valuable services which Prof. Leyton rendered to the University during his tenure of the chair.

A COURSE of eight lectures on the philosophy of mathematics is being given this term by the Hon. Bertrand Russell at Dr. Williams's Library, Gordon Square, W.C.1. The lectures (of which the first was delivered on Tuesday, October 30) are given on Tuesdays at 5 p.m. The present course, which deals with the theory of order, cardinal numbers, and formal deduction, will probably be followed after Christmas by one on the philosophy of the proposition. Applications for tickets should be made to Miss D. Wrinch, Girton College, Cambridge.

THE recently established Department of Technical Optics of the Imperial College at South Kensington has now begun its work. It will be remembered that on the initiative of the London County Council a general scheme for providing instruction in this highly important national work was agreed upon by the several parties concerned in the early part of the year when an Advisory Committee to the County Council representative of the trade, the workers, and other interests concerned was appointed, under the chairmanship of the Rt. Hon. A. H. Dyke Acland. An important part of the scheme was the establishment of the above department, which is administered under the governors of the college by the same committee. In June Prof. F. J. Cheshire was appointed director of the new department; in July Prof. A. E. Conrady was appointed to the chair of optical design, and other subordinate appointments are in hand. During the summer two courses of lectures were given on the designing and computing of telescope systems, and attended by sixty-six students, of whom forty-two came direct from the workshop—a gratifying indication of the recognition by the manufacturers of the importance of this work. About twelve of these were men of academic distinction. The Ministry of Munitions, the National Physical Laboratory, the Royal Observatory, and Woolwich Arsenal were well represented. This session well-attended courses are being given in optical designing and computing, practical optical computing, the construction, theory, and use of optical measuring instruments, theory of the microscope, and microscope technique. Every effort is thus being made to meet the more immediately urgent demands arising in connection with the war. A complete curriculum for optical students will be introduced as soon as the exigencies of the time permit.

THE current issue of the *Quarterly Review* includes two contributions on educational subjects. One, by Mr. Edward Porritt, not only reviews the condition of agricultural education in the United States, but also provides an interesting historical survey of the steps taken to bring the work of the Department of Agriculture to its present high degree of efficiency. The Department of Agriculture at Washington has been a department of first rank in the executive branch of the Government of the United States—a department presided over by a Cabinet Minister—since 1889. In the fiscal year 1916–17 approximately 6,800,000*l.* was being expended by the U.S. Government on the department, on the agricultural colleges and experiment stations, and on extension work, the object of all these branches of the work being to improve all departments of farm economy, to ameliorate conditions on the farms and in the farm homes, and thereby to retain in rural pursuits the men, women, and children who are now on the six million farms of the United States. Mr. J. E. G. de Montmorency writes on national education and national life, and shows in a convincing manner that much useful guidance can be obtained from history in considering current suggestions for educational reform. One of our earliest historical documents, he tells us, for example, is an edict of the Emperor Gratian regulating the salaries of teachers. The proposals of Mr. Fisher's Education Bill are examined in the light of the experience of previous centuries, and after his criticisms Mr. de Montmorency comes to the conclusion:—"It would be a sad thing if a great scheme of educational reconstruction, which at last brings to the doors of the people the larger hope that is essential to a great democracy, were to fail because, in a comparatively small matter of money, the Government lacked that courage which is needful for the conduct of peace as it is for the prosecution of war."

ON October 18 the President of the Board of Education received an influential deputation representative of the North-East Coast Institution of Engineers and Shipbuilders and other technical societies and educational interests in the same district. It will be remembered (NATURE, August 23, vol. xcix., p. 519) that this institution has elaborated an excellent scheme for the training of apprentices, and the object of the deputation, which was headed by the Duke of Northumberland, was to lay before Mr. Fisher its reasoned opinion regarding the organisation of junior day technical schools. The most suitable school for the prospective engineer is of this type, and the institution has already demanded that adequate provision of these schools should be made in the North-East Coast area, which has about 14,000 marine engineering and shipbuilding apprentices, and that these schools should be regarded as in no sense inferior to secondary schools. Mr. Rowell referred in detail to the Board's regulations for junior day technical schools, and expressed the view that the declaration in the regulations that they were "not intended to promote the establishment of courses planned to furnish a preparation for the professions, the universities, or higher full-time technical work" was open to grave exception, as viewing the work of such a school as lying within a blind-alley. The point was, surely, one of spirit rather than of administration, for he could not imagine that the

Board would deliberately arrest a sequential scheme of development, such as that set out in the institution's report. Mr. Fisher promised that the points raised would receive careful consideration. Those who have been intimately acquainted with the working policy of the Board of Education towards junior technical schools will be gratified that a large and influential body of engineers has at last spoken out with no uncertain voice, and will look with renewed hope for the speedy removal of the crippling regulations under which such schools have been governed.

THE widespread disappointment at the Government's decision to postpone for the present any further consideration of Mr. Fisher's Education Bill continues to receive expression in resolutions passed by public bodies and in letters to the Press. Among the latter may be mentioned a letter signed by a number of representative persons, including the Bishops of Oxford and Winchester, the Master of Balliol, Mr. W. L. Hitchens (chairman of Messrs. Cammell Laird), and several Labour members of Parliament. The letter states that the signatories are convinced that they express the opinion of a large majority of their countrymen when they say that no more urgent task confronts the nation than the creation of an educational system which will cultivate more fully the physique, the intellect, and the character of the rising generation of English children, and that it would be little less than a national disaster if the present opportunity were allowed to pass unused. Again and again in the last ten years the nation has been warned that in allowing nearly one-half of its children to leave school before their fourteenth birthday, and more than three-quarters of those between fourteen and eighteen to escape educational supervision altogether, it is creating a moral and economic problem which no intervention at a later age can solve. The chief medical officer of the Board of Education has directed attention to the prevalence among large numbers of school children—one million is the latest figure—of ailments which undermine their vitality, which render futile the efforts of the teachers and the educational expenditure of the State, but can be remedied only by the adoption of a more comprehensive system of physical education and medical treatment. The general character of the right educational policy is not disputed. If it be said that the crisis of a great war is not the right moment to proceed with educational legislation, the answer is that if the improvement of our national system of education was desirable before the war, the war itself has made that improvement indispensable. The letter urges that it is in the public interest that at least the educational proposals of the Bill should be passed into law at a sufficiently early date to be brought into operation before the conclusion of the war. We are glad to see the statement in the *Times* of November 6 that the Government has been so much impressed by the amount of feeling aroused by its decision not to proceed any further with the Education Bill this session that the position is to be reconsidered.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 1.—Sir J. J. Thomson, president, in the chair.—Lord **Rayleigh**: The reflection of light from a regularly stratified medium. The remarkable coloured reflection from some crystals of chlorate of potash described by Stokes, the colours of opals and of old decomposed glass, etc., lend interest to the calculation of reflection from a regularly stratified medium, in which the alternate strata, each of constant thickness, differ in refrangibility. The higher the number of stratifications, supposed perfectly regular, the nearer is the approach to homogeneity in the light of the favoured wave-lengths. A general idea of what is to be expected may be arrived at by considering the case where a single reflection is very feeble, but when the component reflections are more vigorous, or when the number of alternations is very great, a more detailed examination is required. An important distinction reveals itself according to the relative values of the refractivity and thicknesses. In one case a sufficient multiplication of the number of strata leads to complete reflection; in the other it does not.—Sir William **Abney**: Two cases of congenital night-blindness. The two cases were examined spectroscopically. An interesting fact appeared that in their extinction of the different rays of the spectrum all light disappeared throughout the spectrum at the same moment that the colour vanished, and that the *colour* vanished to the normal eye at the same point that it did to the colour-blind. This pointed to the fact that the colourless part of the rays failed to give any sensation of light. As normal eyes see in a faint light with these colourless rays, it is to be presumed that the night-blind owe their blindness in faint lights to the absence of certain retinal processes which the normal eyes possess.—Hon. R. J. **Strutt**: Duration of luminosity of electric discharge in gases and vapours—further studies. (1) The behaviour of jets of luminous gas flowing away from the region of discharge at a low gaseous pressure has been investigated, using the principal permanent gases, also mercury vapour. In a transverse electrostatic field the luminosity is deflected, part of it in most cases going to the positive plate, and part to the negative. But in hydrogen, when the pressure is not very low, nearly the whole of the luminosity is deflected to the positive plate, a small part remaining undeflected. As the pressure is reduced, an increasing part of the luminosity goes to the negative plate. Similar results are observed in mercury vapour. (2) Further observations are recorded on these jets at higher pressures, arranging a spark discharge so that the gas can flow out from it through an orifice into a sustained vacuum. With hydrogen (condensed discharge) the exuded jet of luminosity, about 9 mm. long, shows the Balmer series. The discharge spectrum shows widened lines. These become narrow as the luminous gas emerges. (3) Nitrogen in the same arrangement, with an uncondensed discharge, shows a jet with periodic swellings similar to those observed by Mach and Salcher and Emden when a jet of compressed air, examined by the shadow method, escapes into the open. The wave-length agrees with that to be anticipated from their experiments. (4) This nitrogen jet luminosity is not to be confused in any way with active nitrogen. The time for which it endures is of quite a different order of magnitude, and the spectrum is essentially different.—G. W. **Walker**: Surface reflection of earthquake waves.—Dr. H. S. **Allen**: Characteristic frequency and atomic number. (1) Simple relations are found to hold between the values of the product $N\nu$ for different elements (N being Moseley's atomic number and ν the characteristic frequency). (2) For twenty-five metals it is found that the product can be expressed in the form $N\nu = n\nu_A$ (n a whole number and ν a constant of value $21{\cdot}3\times10^{12}$ sec.$^{-1}$ approximately). (3) The same rule is obeyed in the case of certain non-metallic elements. (4) Similar results are found when the characteristic frequency is calculated from the elastic constants by Debye's formula. The value of n thus obtained is not in all cases the same as that deduced from the specific heats. (5) Application of the theory of probability shows that there is but a small chance of the product $N\nu$ approaching so nearly to integral multiples of a constant frequency by a mere accident. (6) It is found that the atomic num-

bers of Moseley give better agreement with the proposed relation than do the atomic ordinals of Rydberg. (7) The empirical results are discussed from the viewpoint of the quantum theory, and it is suggested that the integer n may be related to the number of electrons concerned in determining the crystalline space-lattice of the element in the solid state. (8) A relation similar in character is found to hold for certain electronic frequencies. In such cases ν_A must be replaced by $\nu_F = 3{\cdot}289 \times 10^{15}$ sec.$^{-1}$ (Rydberg's constant). (9) This relation is considered with reference to the maximum of the photoelectric effect, the limiting frequency of this effect, ionisation potentials, and thermionic potentials.—Dr. C. **Chree**: Historical note on a relation between the gravitational attraction exercised and the elastic depression caused by load on the plane surface of an isotropic elastic solid.

Zoological Society, October 23.—Dr. A. Smith Woodward, vice-president, in the chair.—H. D. **Badcock**: Ant-like spiders from Malaya, collected by the Annandale-Robinson Expedition, 1901–2.—Miss Ruth C. **Bamber**: A hermaphrodite dogfish.

Mathematical Society, November 1.—Prof. H. M. Macdonald, president, in the chair.—J. H. **Grace**: Tetrahedra in relation to spheres and quadrics.—Prof. M. J. M. **Hill**: The continuation of the hypergeometric series.—Prof. W. H. **Young**: Restricted Fourier series and the convergence of power-series.—Prof. E. B. **Stouffer**: Invariants and covariants of linear homogeneous differential equations.—H. W. **Turnbull**: The simultaneous system of two quaternary quadratic forms.

BOOKS RECEIVED.

Principles of Quantitative Analysis. By Prof. W. C. Blasdale. Second edition. Pp. xii+402. (London: Constable and Co., Ltd.) 10*s.* 6*d.* net.

The Student's Handbook to the University and Colleges of Cambridge. Sixteenth edition, revised to June 30, 1917. Pp. vi+703. (Cambridge: At the University Press.) 6*s.* net.

Manuring for Higher Crop Production. By Dr. E. J. Russell. Second edition. Pp. vi+94. (Cambridge: At the University Press.) 3*s.* 6*d.* net.

The Chemistry of Linseed Oil. By Dr. J. N. Friend. Pp. vii+96. (Chemical Monographs.) (London: Gurney and Jackson.) 2*s.* 6*d.* net.

A Roumanian Diary, 1915, 1916, 1917. By Lady Kennard. Pp. vii+191. (London: W. Heinemann.) 5*s.* net.

The National Physical Laboratory. Report for 1916–17. Pp. 67. (Teddington: W. F. Parrott.)

The National Physical Laboratory. Collected Researches. Vol. xiii., 1916. Pp. 278+fig. (London: Harrison and Sons.)

Modern Whaling and Bear-Hunting. By W. G. Burn Murdoch. Pp. 320. (London: Seeley, Service and Co., Ltd.) 21*s.* net.

The Distances, Absolute Magnitudes, and Spectra of 734 Stars. Arranged for Use with Ordinary Star Maps. By T. E. Heath. Pp. iv+52. (Tenby: Miss Crealock.) 2*s.* 6*d.* net.

Foods and their Relative Nourishing Value. By Prof. W. H. Thompson. Second edition. Pp. 38. (Dublin: University Press.) 4*d.* net.

The Pupils' Class-Book of Geography. Scotland. Pp. 96. Asia, with Special Reference to India. Pp. 128. By E. J. S. Lay. (London: Macmillan and Co., Ltd.) 7*d.* and 8*d.* respectively.

Biology. By Prof. G. N. Calkins. Second edition. Pp. viii+255. (New York: H. Holt and Co.)

The Born Fool. By J. W. Byrd. Pp. 316. (London: Chatto and Windus.) 6*s.* net.

Probleme der Volksernährung. By Dr. A. Lipschütz. Pp. 74. (Bern: Max Drechsel.) 2.80 francs.

Power Wiring Diagrams. By A. T. Dover. Pp. xv+208. (London: Whittaker and Co.) 6*s.* net.

Continuous-Current Motors and Control Apparatus. By W. P. Maycock. Pp. xvi+331+4 Appendices and Index. (London: Whittaker and Co.) 6*s.* net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 8.

ROYAL SOCIETY, at 4.30.—The Galvanometric Measurement of "Emotional" Physiological Changes: Prof. A. D. Waller.—The Structure, Evolution, and Origin of the Amphibia. I. The "Orders" Rachitomi and Stereospondyli: D. M. S. Watson.—The Enzymes concerned in the Decomposition of Glucose and Mannitol by *Bacillus coli communis*. II. Experiments of Short Duration with an Emulsion of the Organisms. III. Various Phases in the Decomposition of Glucose by an Emulsion of the Organisms: E. C. Grey.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—President's Address: C. H. Wordingham.

OPTICAL SOCIETY, at 8.—Certain Optical Stores Captured from the Enemy: Lt.-Col. A. C. Williams.

FRIDAY, NOVEMBER 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 5.—The Thermo-electric Properties of Fused Metals: C. R. Darling and A. W. Grace.—Triple Cemented Telescope Objectives: T. Smith and Miss A. B. Dale.

MONDAY, NOVEMBER 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

THURSDAY, NOVEMBER 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Investigation into the Imbibition Exhibited by some Shellac Derivatives: A. P. Laurie and C. Ranken.—Phenomena connected with Turbulence in the Lower Atmosphere: G. I. Taylor.—The Relation between Barometric Pressure and the Water Level in a Well at Kew Observatory: E. G. Bilham.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

FRIDAY, NOVEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

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THURSDAY, NOVEMBER 15, 1917.

ELECTRICAL ENGINEERING.

(1) *The Theory of the Submarine Telegraph and Telephone Cable.* By Dr. H. W. Malcolm. Pp. xi+565. (London: The *Electrician* Printing and Publishing Co., Ltd., n.d.) Price 18s. net.

(2) *Alternating-current Electricity and its Applications to Industry. Second Course.* By W. H. Timbie and Prof. H. H. Higbie. Pp. ix+729. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 13s. 6d. net.

(1) IN the summer of 1850 a small party of engineers arrived at Dover in order to lay a cable across the Channel. One of them—Willoughby Smith, who was afterwards president of the Institution of Electrical Engineers—has left an interesting record of their adventures. At that period it was considered absolutely unnecessary to test copper wire. All copper wires were supposed to have the same conductivity. The cable was twenty-five miles long, made up of short lengths of wire which purported to be No. 14 Birmingham Wire Gauge, but which varied in diameter. It was covered with gutta-percha, so that the outside diameter was about half an inch. No armouring of any kind was used. The cable was coiled on board the tug *Goliath*, and the party had to wait some weeks for a calm day. The project excited much good-natured ridicule amongst the town folk. A man was found cutting the cable with his knife to show his friends that there was a wire inside. A spectator was heard explaining to interested listeners that it was impossible to pull a cable of this kind 25 yds. long resting at the bottom of the sea. It was, therefore, absolutely impossible to pull one twenty-five miles long. He evidently thought that the function of a cable was similar to that of a bell-pull. On an ideal calm day the pioneers laid the cable from Dover to Grisnez, but they were destined to bitter disappointment. The letters printed by the type-writing instrument at Grisnez were so mixed that the few messages received were quite undecipherable. To make their discomfiture complete, the anchor or the trawl of a fishing-smack cut the cable in two not many hours after it was laid. They were thus prevented from carrying out experiments which would probably have enlightened them considerably on the laws governing the transmission of submarine signals. As it was, they had no conception that their failure was mainly due to ignorance of the laws of electrical capacity and induction.

In 1866, when world-wide interest and enthusiasm were aroused by the laying of the Atlantic cable, one would have anticipated that a book on the theory of the subject would be published, at least in a few years' time. The development of the theory, however, was difficult, and needed laborious investigations by mathematical physicists. Most of the cable companies train their own engineers, giving them an insight into both their technical and commercial activities. Few cable experts, therefore, have sufficient mathematical knowledge to understand the writings of Kelvin, Heaviside, and Pupin, and so there was little demand for a text-book on the subject.

When, however, submarine telephony began to be studied the importance of the labours of Heaviside and Pupin were appreciated. The engineers of the Post Office and of the late National Telephone Company studied the theory enthusiastically and carried out most painstaking work in their research laboratories. They were helped in no small measure by the papers of Kennelly. Fleming, also, by numerous papers and lectures, rendered invaluable help to our telephone engineers. The recent great advances in submarine telephony are due to the recognition by engineers of the importance of the work done by the mathematical physicists. The application of these results to practice, however, was a triumph for which all the engineers concerned deserve the greatest credit.

Let us compare, for instance, the simple order for twenty-five miles of cable given to the Gutta-Percha Company in 1850 with the specification for the sixty-four-mile Howth and Aber Geirch (Ireland and Wales) submarine telephone cable laid in 1913. The specification says that the attenuation constant of the cable must not exceed 0·016 per naut (nautical mile) for sine-shaped waves of frequency 800. Considering that the value of the attenuation constant depends on many factors, this clause proves the confidence of the practical engineer in his ability to gauge the properties of the materials he uses and his faith in theory. Experiment later proved that the actual value of the attenuation constant was 0·015 at the specified frequency. The engineers had few, if any, misgivings that the cable might prove a failure. Once they had determined the physical constants of the cable, they knew from their laboratory experiments that they could calculate the quality of the speech transmitted. The only evidence of lack of faith, perhaps, is that they connected Aber Geirch with Manchester, and Howth with Dublin, by aerial lines of copper having the abnormal weight of 600 lb. per mile. We know that, if the position of the "loading" coils and their sizes had not been calculated by elaborate and lengthy mathematical formulæ, speech between Manchester and Dublin would have been impossible.

At first sight it is not obvious why the theory of the submarine telephone cable should be simpler than that of the submarine telegraph cable. The reason is that speech-sounds can be treated as periodic waves. The microphone transmitter also is admirably adapted for producing these waves, and the telephone receiver is a marvellously sensitive instrument. The working of the receiving apparatus of a submarine cable, however, depends on what electricians call transient phenomena. The mathematical solution is given in a

Fourier series, each term of which has an exponential factor. It is, therefore, much more unmanageable.

If we except Dr. Fleming's introductory textbook, this treatise is the first to give a complete account of the electrical theory of the transmission of signals along a submarine cable. The industrious student, provided he has a good mathematical foundation on which to build, can readily acquire the whole practical theory from this work. He will also find suggestions for improved methods of submarine telegraphy and for improving cables, both of which are very promising subjects for further mathematical and physical research. Hitherto radio-telegraphy has acted largely as a "feeder" for the submarine cable companies. After the war it is unlikely that the radio-telegraphists will be content to play this subsidiary *rôle*. Cable engineers, therefore, are alive to the necessity of making continual improvements in their methods, and a book like Dr. Malcolm's should prove a great help to them.

In the earlier portions of the book a *résumé* is given of the necessary mathematical theorems. The complete solutions are also given of the fundamental equations of transmission, particular stress being laid on the transient phenomena. Perhaps the treatment in this portion of the book is a little too modern. It is very tempting to define the sine and cosine functions by means of series, but to prove that they are periodic functions of 2π is extremely difficult. The author's proof, although ingenious, is not rigorous. The values of the ordinates of the sine and cosine curves are obviously not calculated from the series. The ordinary clumsy geometrical definitions of the hyperbolic sine and cosine might have been omitted with advantage. The negative sign in Formula 44 is inadmissible, but this does not follow from the proof given. The statement that the root with the negative sign is either *less than zero* or negative is rather quaint. On p. 299 we come across a divergent series due to Heaviside, and we are told that it is to be taken as far as its smallest term. As this needs explaining, we turn up Heaviside and find that the only comment he makes on it is that it is lucky that it is divergent. A reference to a book on modern analysis such as Whittaker and Watson's would, in this connection, be a help to the student.

As to the author's nomenclature, definitions, and mathematical methods we have only minor criticisms to offer. The numerous and excellent diagrams illustrating the formulæ are worthy of the highest commendation. The calculation of all the curves shown must have required a great deal of labour. We can heartily recommend the book to cable and telephone engineers and to physical mathematicians desiring subjects for research. The Committee of the Privy Council for Industrial and Scientific Research would, in the reviewer's opinion, be well advised to give grants to encourage mathematical research on some of the problems discussed by Dr. Malcolm.

(2) This book is not written for the designer. It is written, we are told, for the engineer who is responsible for the working of the machinery, and for the purchaser who pays the bills and seeks the profit. The special features of the book are the numerous questions and problems scattered throughout the text and the summaries in large type of the contents of the various chapters. The results given are trustworthy and can be easily understood by readers with very limited mathematical knowledge. Occasionally the authors seem to get a little weary. The appendix, for instance, refers us to p. 54 for a mention of the Tirrill voltage regulator. We are there told that it "is rather a complicated device involving the interaction of solenoids, differential magnets, levers, and contacts which it is not in the province of this book to describe, as no new principles are to be learned thereby." If we insist, however, on knowing about it, we are told to secure the "bulletins and instruction sheets" of the General Electric Company. After saying all this, the principle is described quite satisfactorily.

We wonder what the old-fashioned Cambridge don would have said to this question (p. 150): "How many dollars less per year does it cost to operate a 50 kv.-a., type S transformer (Table A) than a 50 kv.-a., type SA transformer? How many dollars more can we afford to pay for the 'S' than for the 'SA'?" Apart from the wording, it is really a very admirable question, teaching the student how to study a maker's catalogue intelligently. An excellent feature of the book is the stress laid on the distinction between "economy" and "efficiency." The most efficient apparatus is by no means the most economical, as the first cost and maintenance expenses have to be taken into account. This very obvious consideration is often neglected by beginners.

It may be more logical to talk about capacitance than about capacity, but when the word is repeated twenty-two times on one page (p. 376) it gets very monotonous. The authors should have stated that the model to represent the capacity of a transmission line (p. 376) is applicable only when the load is balanced.

A. RUSSELL.

THE THYROID GLAND.

The Thyroid Gland in Health and Disease. By Major R. McCarrison, I.M.S. Pp. xvii+286. (London: Baillière, Tindall, and Cox, 1917.) Price 12s. 6d. net.

IN this well-appointed volume, with excellent illustrations, Major McCarrison has collected much useful information about the thyroid and parathyroid glands in health and disease. The work is of peculiar value in that the author has an intimate experimental and clinical acquaintance with the subject, and this first-hand knowledge has guided him in discriminating between the many and conflicting theories that have been advanced as to the physiological *rôle* of these glands. He is at the same time in a position to advance views of his own of far-reaching importance.

The volume is divided into three parts. About a third of its bulk deals, first, with anatomy and physiology, and, secondly, with the factors which determine the departure of the thyroid and parathyroid glands from the normal. The remaining two-thirds of the volume are devoted to a consideration of the diseases of the thyro-parathyroid glands.

The anatomy and histology of the glands are admirably described, and in no other work can one find so concise and accurate an account of the histological alterations presented by the thyroid in its various degrees of physiological activity. The physiology of the glands, despite the large amount of recent work upon them, is still obscure, and some of the functions ascribed to them by the author do not carry conviction. His statement that "the thyroid gland is to the human body what the draught is to the fire" is a particularly happy one. Further than that it is, perhaps, unsafe to go. The thyroid stimulates metabolism in general, and the growth of certain organs in particular. Hence it follows that secondary results occur in the body from the increased activity of the stimulated organs. There is evidence, indeed, that the thyroid is closely co-ordinated with other ductless glands, and that pathological alterations in its activity upset the normal balance between them. There are also sex differences as yet imperfectly understood. Excess of thyroid, for example, checks the development of the pituitary body in the female, but accelerates it in the male. Further differences in the sexes result from this peculiarity.

Major McCarrison insists upon the great importance of the thyroid in maintaining the health and efficiency of the body at different stages of the life-history of the individual, and shows how its activities are normally influenced. Some of his statements cannot escape criticism. That "married men under forty years of age are, on the whole, of better physique than the unmarried" may be true enough, but that this is "a fact which is probably dependent in considerable measure on the maintenance of thyroidal activity which marriage ensures" is an assumption that it would take much evidence to prove.

The factors which bring about pathological changes in the thyroid Major McCarrison discusses in detail; and this is one of the most valuable sections in the book. The author divides them into three categories—nutritional, infectious, and psychic. Major McCarrison has established beyond doubt that endemic goitre is frequently the result of infection of the alimentary canal by the fæcal contamination of drinking water. The exact organism or organisms responsible have not been isolated, and, indeed, Major McCarrison's observations leave one somewhat confused as to whether the virus is the product of a special organism or of the normal bacteriological flora of the colon. Predisposing factors are of some importance, and their nature is fully considered. In spite of the strong evidence brought forward, one is not quite convinced that Major McCarrison has altogether solved the problem of the causation of endemic goitre. Does the condition occur in all districts where the drinking water is thus contaminated? These must be fairly numerous. On the other hand, goitre may be very prevalent, as it is in a district in New Zealand, where the water supply is entirely derived from deep artesian wells, the water from which is stated to be bacteriologically pure. In that district radium emanations in the water are generally blamed.

The major portion of the volume is an excellent work on the diseases of the thyroids and parathyroids, and as such is a valuable addition to medical literature. Of its many admirable features, that of the treatment of these conditions deserves especial mention. As is to be expected from the views of the author, the promotion of a healthy intestinal condition is of paramount importance in treatment. The author lays stress on the frequency with which Graves's disease is associated with, and presumably caused by, intestinal disorders. He regards the increased activity of the thyroid as a result of toxæmia, and until this is remedied treatment based on diminishing the secretion by medical or surgical means is obviously misapplied.

The volume is full of interesting information, and will be welcomed by physiologists and medical men generally. P. T. HERRING.

OUR BOOKSHELF.

The Use of the Voice. By the Rev. T. Grigg-Smith. Pp. 118. (London: S.P.C.K., 1917.) Price 2s. 6d. net.

THIS is an admirable little book written by a teacher of experience who realises the importance of careful training in the use of the voice both in singing and in reading. The mechanism of the larynx is described in simple and, so far as possible, in untechnical language, and there is a succinct account of the mechanism of breathing. The author favours the view that the kind of breathing best adapted for the development of a good voice is neither wholly diaphragmatic nor wholly higher costal, but what may be termed general breathing; in other words, all parts of the mechanism of the chest should be brought into play. Very sensible instructions are given as to the use of the resonance cavities on which the quality of the voice largely depends. Graduated exercises on vowel and consonant sounds are highly recommended, and there can be no doubt that, following the good advice given, the best use can be made of the pupil's structures for voice production. We accept the author's view that far too little attention is paid to the education of the voice both in ordinary conversation and in public speaking, and that we have, therefore, often to suffer from mumbling, indistinct utterance, lack of modulation, and incorrect accentuation. Not only should one be trained to express his thoughts when "on his feet," but he should also be able to express them in sounds that give pleasure to those who listen. How very often is

this not the case and we are glad when the speaker sits down. There is an excellent chapter on "stuttering," with many wise suggestions.

J. G. M.

Practical Cheesemaking: A General Guide to the Manufacture of Cheese. By C. W. Walker-Tisdale and Walter E. Woodnutt. Pp. 182. (London: Headley Bros., Ltd., 1917.) Price 4s. 6d. net.

THIS book deals with the technical side of cheesemaking, and is intended to serve both as a textbook for dairy students and as a reference-book for practical cheesemakers. The subject-matter is well chosen, and whilst the explanations which are given at each stage are clear and simple, there is a great deal of practical information which it has previously been difficult to obtain in print.

Very properly, a considerable amount of space is devoted to the composition of milk and the methods which must be adopted if a milk suitable for cheesemaking is to be obtained. This side of the subject cannot be put forward too strongly, for, unless the cheesemaker can start with a reasonably pure product, no skill on her part can turn it into really first-class cheese.

Full working details of the methods used in analysing milk by the Gerber test and by the lactometer are given, also the usual tests for obtaining information as to the purity of the milk in respect of cleanliness. The nature and preparation of rennet are dealt with, and instructions given for the making of home-made rennet. The chapter treating of starter is a particularly good one, from both the theoretical and the practical points of view.

About half the book is devoted to the practice of cheesemaking, and the preparation and properties of all the best-known British varieties are dealt with in detail. This portion of the book is to be strongly recommended, for the authors' wide practical experience is drawn upon with the best results. The chapter on faults or defects of cheese should also be specially noticed.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

On an Appearance of Colour Spectra to the Aged.

MAY I suggest that the appearances described by Mr. R. Brudenell Carter in NATURE of November 1 all harmonise with the assumption that their cause is in some way due to diffraction?

The fact of the blue internal band and the red external band, and that the diameter of the colour circle increases in size in approximate ratio to the distance of the light viewed, seems clearly to point to this, no less than the fact that when the pupil is contracted, or when the light is viewed through a pinhole, the appearances vanish, because the actual number of diffracting elements upon which the light impinges would then be too small to give rise to the appearance. The spacing and the number per unit area of the diffracting elements could readily be estimated from the data so clearly given. Whether they take the form of particles or of lacunæ in the humours of the eye, or whether due to some alternating structure of the lens, is a matter on which I am not competent to express any opinion.

It is interesting that Tyndall had a somewhat similar case brought to his notice, to which reference is made in his "Notes on Light" delivered at the Royal Institution in 1869 (Longmans, Green and Co., 1890, p. 54) in the following words:—

"One of the most interesting cases of diffraction by small particles that ever came before me was that of an artist whose vision was disturbed by vividly coloured circles. When he came to me he was in great dread of losing his sight, assigning as a cause of his increased fear that the circles were becoming larger and the colours more vivid. I ascribed the colours to minute particles in the humours of the eye, and encouraged him by the assurance that the increase of size and vividness indicated that the diffracting particles were becoming *smaller*, and that they might finally be altogether absorbed. The prediction was verified."

JULIUS RHEINBERG.

23 The Avenue, Brondesbury Park,
London, N.W.6, November 5.

I AM much obliged to you for permitting me to see Mr. Rheinberg's interesting letter, and am humiliated by the proof of my forgetfulness of the passage from Tyndall, which I must often have read in past years. But, as a pathologist, I incline to my supposition of lenticular inefficiency, perhaps only an excess of that which is universal as life advances, for I do not see how the occurrence of a cloud of particles in the ocular media, in otherwise healthy and perfectly effective organs, is to be explained. Nor is it probable that the cloud, if it existed, would be of similar density in the two eyes, or that it could exist at all without some impairment of sight. In my own case, at least, the colour circles of the two eyes are of equal size and brightness.

R. BRUDENELL CARTER.

76 South Side, Clapham Comman, S.W.4,
November 10.

Paraffin a Scottish Product.

IN Lt.-Commdr. Wimperis's interesting article on "Coal-gas for Motor Traction," which appears in NATURE of November 1, he says:—"Paraffin can be used quite well on slow-moving vehicles . . . but this, again, is not home-produced."

I should like to point out that paraffin is, and always has been, a Scottish product; and it is fortunate indeed for the country that it is so. No doubt Lt.-Commdr. Wimperis is thinking of the similar petroleum products which are imported, but paraffin oil distilled from shale is exclusively a home product. So satisfactory is paraffin oil as an engine fuel that it has been adopted by the Board of Agriculture for Scotland for use by their agricultural tractors on its merits in preference to the foreign product.

H. R. J. CONACHER.

High Holm, Horsewood Road, Bridge of Weir,
November 3.

MR. CONACHER is quite right. I should have said that before the war Scotland was able to produce a very useful, though small, percentage of our home demand for paraffin. What the proportion may be now I do not know.

H. E. WIMPERIS.

November 8.

FERRO-CONCRETE SHIPS.

THE heavy demand for steel and iron for munitions has enforced economy in the use of these materials for other purposes, and led to the substitution of other materials wherever possible. The shortage of shipping and the necessity of making good war losses have produced recently a considerable development in the building of ferro-concrete vessels of a sea-going type, especially in the Scandinavian countries, where the losses have been great and the scarcity of metals has been much felt. Reference has already been made in our Notes columns to articles in *Engineering* giving interesting information as to what has been done in Norway in the building of such vessels, and most of the experience available at present has been obtained in Norwegian yards.

The production of concrete and ferro-concrete vessels such as barges, intended for quiet waters, is by no means novel, but the problem becomes complicated when the vessel is to undertake sea voyages under her own propulsive power. This is principally owing to the uncertainty of the loads imposed on the vessel, especially when in turbulent waters. Of course, the same difficulty occurs in the design of steel vessels, but the strength of these is determined almost entirely by experience, and there is plenty of experience available and embodied in the rules of the various registration societies. Until experience has accumulated of the actual behaviour of ferro-concrete sea-going vessels no rules will be formulated. The leading societies, however, are taking an active interest in the development, and Lloyd's Register has approved of plans up to 500 tons. The maximum weight of vessel projected so far appears to be 1000 tons.

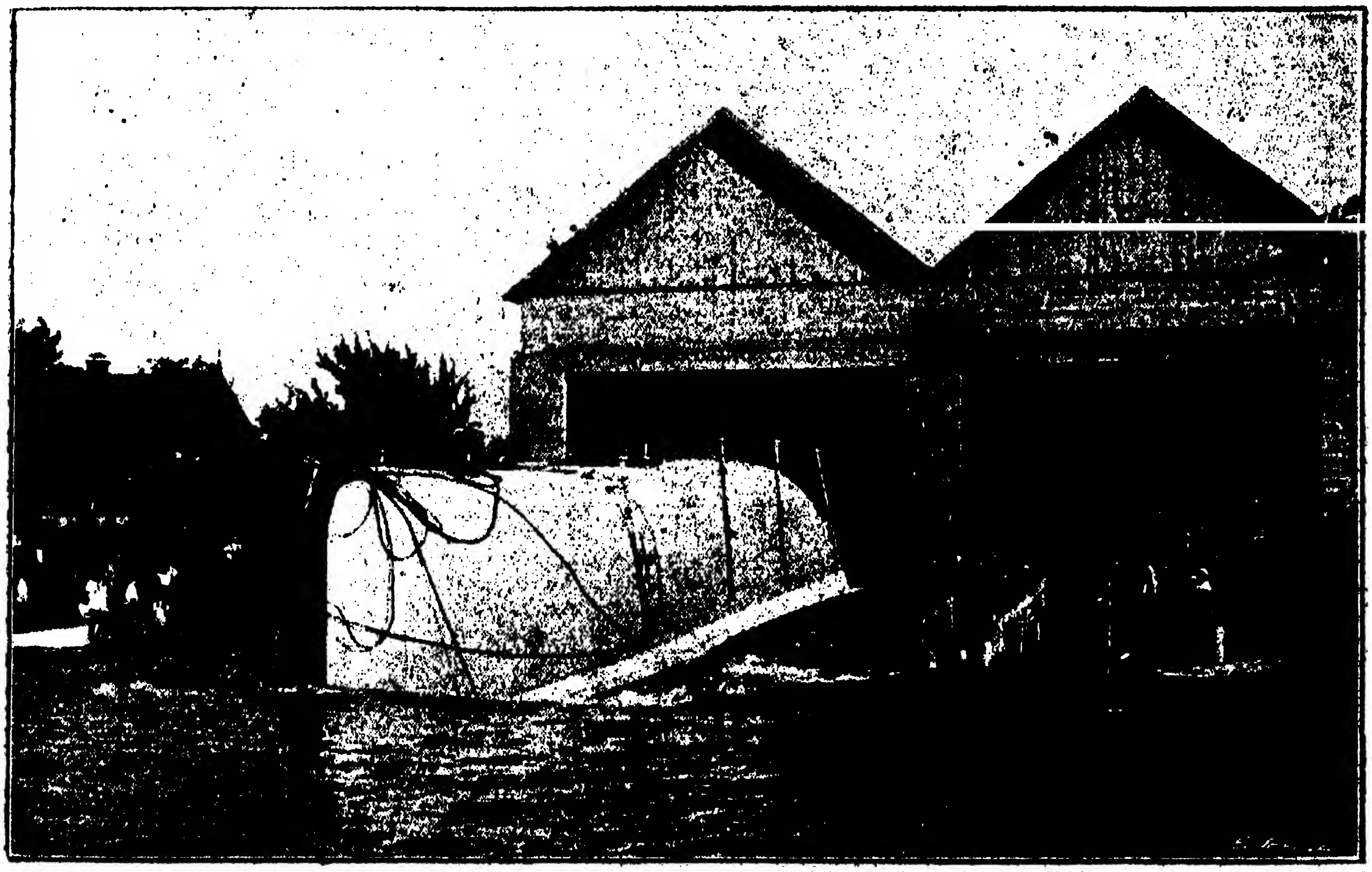

FIG. 1.—Vessel being launched, bottom uppermost.

Concrete is weak under tension, and the reinforcement in ferro-concrete structures is always placed so as to take the tension, leaving the concrete to take the compressive stresses. There is difficulty in doing this throughout the structure of a ship, and lack of effectiveness in this matter may produce cracks, which, in the presence of salt water, may lead to trouble. Strict inspection and overlooking during construction are of much greater importance in all ferro-concrete structures than in buildings of other types. This is owing to the nature of the materials used and to the possibility of the reinforcing bars becoming displaced during the casting and ramming process. The life of the ship will depend probably upon the chemical composition and water-tightness of the concrete, on the proper placing of the reinforcement, and on the effect of salt water upon the concrete and upon the reinforcement if there are cracks.

Ferro-concrete vessels weigh considerably more than steel vessels of corresponding dimensions; hence their cargo-carrying capacity is less. This will probably make it impossible for them to compete against steel vessels in normal times. Owing, however, to the ease with which repetition orders for vessels of the same size can be executed, and to the reduced quantity of steel required in their construction, their production will certainly be useful during the war.

Particulars are given in *Engineering* of several of the vessels already built in Norway. The *Namsenfjords* is 84 ft. long, 24 ft. broad, and 11·6 ft. deep. The hull is monolithic with the deck and frames round the hatches. There are two large wooden fenders outside the hull, and the ship has a Bolinder motor and appliances for prompt loading and discharging. She is well suited for carrying timber, and will be put on a Norwegian coasting route. She passed her trial trip on August 1. Another vessel, ordered by the South Varanger Iron Ore Company, will have double sides and bulkheads, since ore does not take up much space.

The Porsgrund Cement Casting Company took up the question of ferro-concrete vessels in 1913, and built a bridge pontoon in 1915 which is claimed to be the first vessel of this type built in Norway. This vessel was cast with double boarding, or shuttering, in the walls. Experience of this method showed considerable difficulties; the arrangement of the reinforcement gave trouble, and there was no guarantee that the iron would be in proper position. Casting the concrete also was troublesome, and one or two places were found where faults had to be remedied. It was considered that these difficulties with pontoons having fairly rectangular section would become very pronounced in building vessels of ordinary section, and Mr. Harald Alfsen has overcome them by building the vessels bottom uppermost, and using an inner shutter, or outer boarding only, so far as the vertical sides are concerned. This plan was adopted with the lighter *Beton I.*, interior shuttering only being used. This vessel is a 200-ton deadweight-carrying motor vessel; the calculations and design were prepared by Messrs. Bonde and Norman. As the vessel is intended to be sea-going, the reinforcement was made 50 per cent. heavier than in lighters intended for inland waters, rib and girder dimensions were increased, and a fat concrete mixture of 1 to 2 without cobbles was used. The wall thickness is 1·97 in.

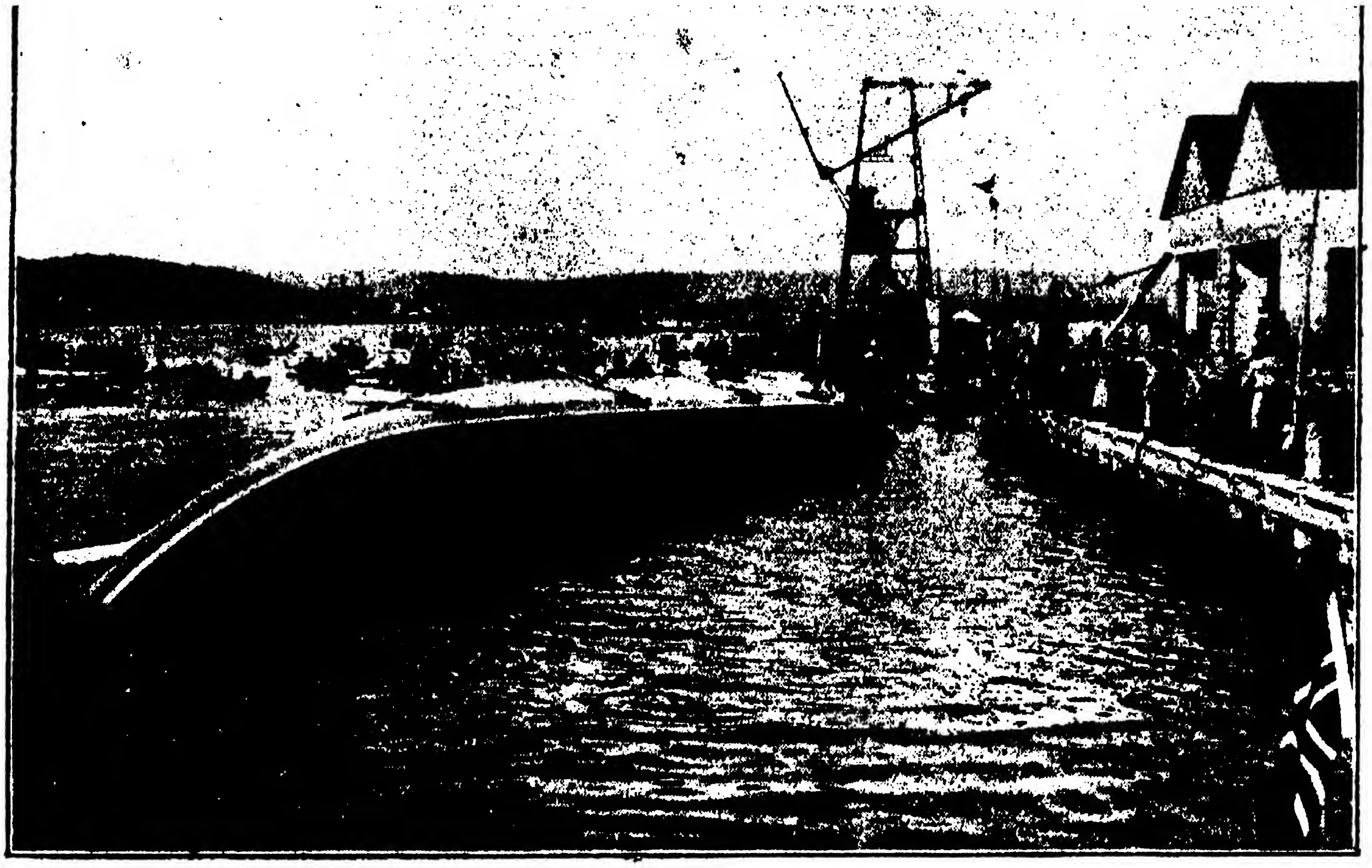

FIG. 2.—Vessel turning over.

The shuttering was built on a sledge, which followed the vessel into the water at the launch. Fig. 1 shows the vessel travelling down the ways, bottom uppermost, as built. On becoming

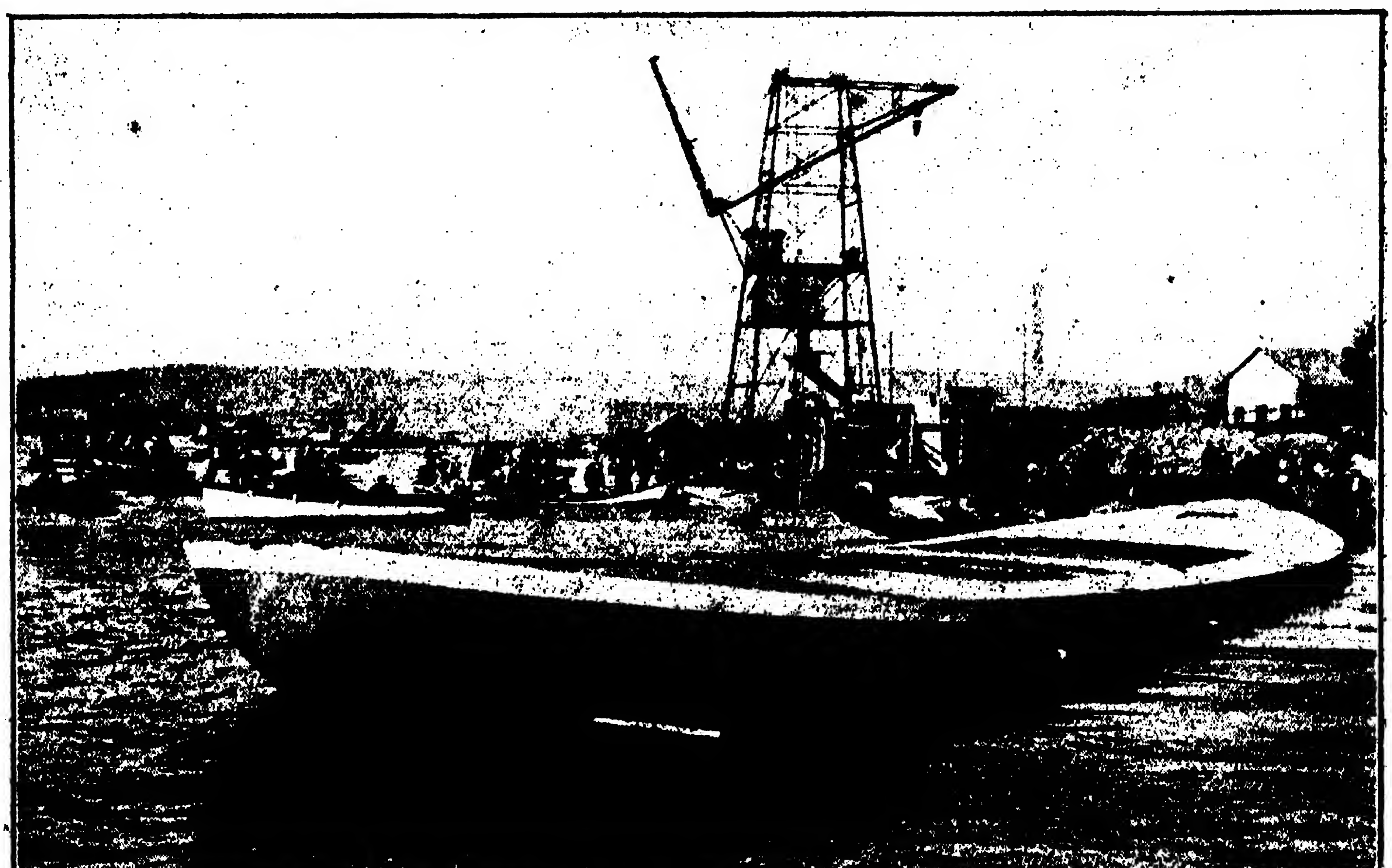

FIG. 3.—Final stage of launching.

fully water-borne the vessel is in stable equilibrium, and the turning right side uppermost is accomplished by permitting the air to escape from the interior; the vessel sinks in the water until a draught is reached for which the equilibrium becomes unstable, and the vessel then turns over without further aid until the deck is uppermost. Fig. 2 shows the vessel with the turning operation about half accomplished, and in Fig. 3 the vessel is seen floating in its ordinary position.

The first vessel took about six weeks to arrange the boarding and reinforcement, and two days to cast; three weeks were allowed for the concrete to set. It is estimated that the next vessel can be done in half the time, since the same shuttering can be used again.

W. DU BOIS DUDDELL, C.B.E., F.R.S.

THE death of William Du Bois Duddell on November 4, at forty-five years of age, leaves a gap in the ranks of our men of science which it will be difficult to fill. His was a rare and precious gift, for he had, in the highest degree, extraordinary patience and scientific instinct. When a problem was set him, however difficult, however insoluble it might appear to be at first, he was never satisfied until he had obtained a solution. It was an inspiration for anyone to have the privilege of helping him in a piece of scientific work. I shall always remember the development of his oscillograph. We were working together on the study of the alternate current arc and were using a laborious "point by point" method for obtaining the curves of current and potential difference. He had set his mind on the production of an instrument that would record the curves instantaneously, and at this problem he worked continuously. He made the first instrument in his workshop at home and brought it along to test; the damping was unsatisfactory, and we set to work to find a method of damping that was efficient. In the end he made a separate channel, with incredibly thin walls, for each strip, and succeeded. It was remarkable that, although the first instrument was designed by eye, the final form of the oscillograph, so far as the vibrator was concerned, did not differ very much in its principal dimensions from the original instrument. Theory enabled the best conditions to be determined, but a full understanding of theory did not lead to a very great improvement. Duddell's instinct as a designer gave the right dimensions from the start. No one who saw it will forget the demonstration that was given by Duddell before the Institution of Electrical Engineers of his instrument, perfect in every detail. There is no doubt that its production marked an epoch in the experimental investigation of alternating current phenomena. If genius is an infinite capacity for taking pains, then Duddell had genius of the very highest kind, for his patience was boundless. His gift as an instrument-maker was hereditary, for he was connected with the great Du Bois family, famous in that home of watchmaking, Switzerland, for its products.

Duddell's rise to the front rank of scientific men was meteoric. Soon after his paper on oscillographs (the first edition of which had been given before the British Association in Toronto) he read a classical paper on the resistance of the electric arc before the Royal Society. It was in the course of this work that he discovered the "singing arc," which formed the starting point in the development of the Poulsen arc, now so largely used in wireless telegraphy, and built the first really high frequency alternator. It was necessary, in order to prove his theory, that a current should be sent through the arc of such a frequency that sensible variations in the temperature of the arc could not be produced by it, so he designed and built an alternator giving 120,000 cycles per second, a frequency which at that time no one had attempted to produce by a mechanical alternator.

Not only was Duddell's gift as an inventor of the highest order; he had also rare skill as an experimenter; his experiments always worked. I can never remember having seen a lecture experiment of his that failed, while his power of talking clearly was a gift possessed by few; he reached, I think, almost the highest point in his career as a lecturer in the demonstration on "Pressure Rises" that he gave when he was elected president of the Institution of Electrical Engineers for the second time. The experiments were nearly all difficult, and liable to go wrong, but they all succeeded, and his model of the oscillating arc was a triumph of demonstration.

Duddell was made a fellow of the Royal Society in 1907, and his was one of the few cases in which election took place at the first time of asking, for he was elected on the first occasion on which his name appeared on the list of prospective new fellows. In 1912 he was awarded the Hughes medal. He was president of the Commission Internationale de Télégraphie sans Fil. In 1907 he was president of the Röntgen Society, and had been hon. treasurer of the Physical Society since 1910. He was a member of the Advisory Council to the Department of Scientific and Industrial Research and of the Board of Inventions and Research of the Admiralty. Last August the honour of Commander of the Order of the British Empire was conferred upon him.

As a chairman of committees Duddell was always excellent, being businesslike and to the point; no time was ever wasted when he was in charge. He was no mean linguist, and those who have seen him conduct an international conference will remember his gifts, and the infinite tact with which he was always able to reconcile the differing points of view and characteristics of men of different nationalities. It is an unspeakable grief to his friends that he has died so young, though few men have ever achieved so much in so short a time; but he worked himself to death. He was always in his laboratory or his office; he scarcely

ever took a holiday. He was at school at Cannes, and at that time the French took less interest in sports and games than they do now, so that h had none of that love for outdoor pursuits whi is so characteristic of the average Englishman. He had no enemies, for everyone who knew him liked him for his kindliness and his extraordinary modesty, though, when the occasion arose, he could show great firmness and decision. He will long be remembered as a great man of science and a great gentleman. E. W. MARCHANT.

NOTES.

IN its column entitled "Through German Eyes," the *Times* of November 13 gives prominence to notices appearing in German newspapers of further important steps now being taken to strengthen and consolidate the great dye syndicate, of which the seven largest firms control a capital of nearly 12,000,000*l*. The three largest undertakings in this group, namely, the Höchst colour works, the Badische Anilin- und Soda-Fabrik, and the Bäyer colour factories, are each to increase their capital from 2,700,000*l*. to 4,500,000*l*. These increases of capital, raised by the Rhenish firms themselves, will be supplemented by additional sums to be provided by the German Government, so that the total capital will be more than 20,000,000*l*. The German Press appreciates fully the prominent part played by chemical industry in the war, and attributes largely to this group of factories the extraordinary striking force displayed by Germany on the fields of battle. The intimate relationship between synthetic dyes and high explosives has slowly dawned on the British public, but it is deplorable that even after three years of war the English colour industry is in a position even more disorganised and chaotic than it was at the outbreak of hostilities. A beginning of co-ordination and co-operation in dye production has developed among the Lancashire firms, but the State-aided company which was to have united the colour trade and to have administered the research grant of 120,000*l*. for the benefit of all the manufacturers concerned, so far from effecting these vital improvements, has actually been the direct exciting cause of additional friction and needless internal competition. Now that public appeals are being made for more Government support for this company it is surely time that a non-political, impartial Parliamentary inquiry should be set on foot to ascertain how the earlier grants have been expended, and whether the existing organisation is adequate to meet the competition of a powerful enemy syndicate operating under expert and scientific management.

IN a speech delivered on November 8 the President of the Board of Agriculture again directed public attention to the gravity of the food outlook, and outlined clearly the concatenation of circumstances which render it inevitable that even the establishment of peace cannot bring automatically the proverbially associated plenty. Of special interest was Mr. Prothero's warning that the productive power of the soil of Europe is falling. Not only have large cultivated areas become desolate wastes through the direct ravages of warfare, but even regions remote from the firing line are losing their fertility for want of labour and fertilisers. That is true of Germany; it is also true of areas in this country. Mr. Prothero pointed out that the yield per acre fell in 1916; it has fallen still further in 1917, and, so far as existing areas go, will almost certainly undergo a further decrease. On broad general grounds this prediction is doubtless reasonably probable, but statisticians will scarcely regard the results of the last two seasons as a sufficient basis for such a broad generalisation, especially as these have been years in which all conditions alone have notoriously been unfavourable to a heavy grain crop. The average yield of wheat per acre in England and Wales this year is estimated at 29·88 bushels, of barley at 30·36 bush., and of oats at 38·49 bush., as compared with 28·60 bush., 31·11 bush., and 39·95 bush. respectively in 1916, and averages of 31·40 bush., 32·44 bush., and 40·03 bush. respectively for the ten years 1907–16. These differences are well within the range of natural variations, and can scarcely be adduced as evidence of specific decline in fertility. It is certain, however, that the increasing foulness of the arable land owing to lack of adequate labour for the necessary cleaning operations must tend towards a reduction of crop. On the other hand, it is equally certain that an extended and more skilful use of fertilisers for corn crops would lead to an appreciable increase of the average yields. An instance in point is furnished by a report on oat manuring experiments recently issued by the West of Scotland Agricultural College, in which it is recorded that on the average of seventeen experiments in three years the oat yield of $41\frac{1}{4}$ bush. on the unmanured plot was increased fully 30 per cent. by the combined use of superphosphate, kainit, and sulphate of ammonia. The wheat crop offers probably less scope for intensive manuring, but undoubtedly is capable of very substantial improvement on many farms.

IT was remarked in these columns, at the time of the establishment of the Air Board, that more co-ordination was needed between the various branches of the Air Services, and that the Air Board should do much to secure this end. The introduction of the Air Force Bill shows that the Government now intends to make such co-ordination complete by the establishment of an Air Council, which is to enjoy a status similar to that of the Admiralty and the Army Council. The *Times* remarks that this is a landmark in the history not only of aviation in this country, but also of the armed forces of the Crown; for it formally recognises the air as a distinctive fighting element, and provides for the establishment of a third service, to be called the Air Force. Those whose labours lie in the field of scientific aeronautical research will welcome the new *régime* as a step of great importance. A closer connection is very desirable between scientific work and practical aircraft design, and there seems little doubt that this end will be achieved much more rapidly if the present air services are organised as a single force and controlled by one central council. It is, indeed, a triumph for aviation that in only a few years of development it should rise to such importance as to cause the creation of a third Service, and it is pleasing to reflect that scientific research has played a very important part in this rapid development of the new industry.

A RECENT lecture delivered by Major Astor, M.P., on "Health Problems and a State Ministry of Health," at the Royal Institute of Public Health, was the third of a series of lectures and discussions on public health problems under war and after-war conditions. Not unnaturally, on this occasion, the bulk of what the speaker, and those who took part in the discussion, had to say related to the Ministry of Health, and Major Astor, having declared that the Local Government Board, and not the Insurance Commission, would form the best nucleus for a Health Ministry, there was a tendency on the part of other speakers to take sides. Amongst those who showed no inclination to declare in favour of any particular body was Mr. H. A. L. Fisher, President of the Board of Education, who presided over the meeting, and remarked, in the course of his speech, that though, as matters now stood, there was considerable possibility of overlapping, it did not

of necessity follow that the system was bad. Before condemning it he desired first of all to learn whether or not it worked well or ill; whether or not it was economical, and if there was friction. With reference to this question, it may be pointed out that Lord Rhondda has stated that the Board of Education and the Local Government Board have had differences of opinion as to their respective shares in the work of child welfare, but that before he left the latter Board an agreement had been arrived at. Possibly it was because there had been an agreement that Mr. Fisher desired to be non-committal.

THE organisers of the meeting held to take steps to form a representative association of British chemists, held at the Manchester School of Technology on November 10, are to be congratulated on the result of their efforts. Seldom have chemists been brought together in such numbers, at least 500 being present. Much criticism was levelled at the Institute of Chemistry, which has hitherto been held to be too exclusive and not sufficiently representative of the rank and file. In justice to the institute, however, it was recognised by the speakers that it has done a great deal for chemists and has within recent times evinced a disposition, as a war measure, to open its doors to properly trained and qualified chemists on a more liberal basis within the limitations of its constitution. The Provisional Committee of the new association obtained the support of the meeting to the main objects, but it agreed to submit its scheme to the council of the Institute of Chemistry before proceeding to definite incorporation, on the understanding that the institute, which has been established for forty years, should be asked in the first place to adopt its aims. The chairman of the meeting, Dr. Rée, intimated that the Provisional Committees for Manchester and Birmingham have already had an informal conference with the representatives of the institute, and that the latter has expressed its sympathy with the general aims of the proposed association. A great deal depends on what constitutes a chemist, and much will yet depend on the extent of the training and qualifications regarded by the organisers as necessary to justify registration of a candidate under the scheme. The meeting showed no disposition to claim that pharmaceutical chemists, many of whom are held to be sound chemists in the technical and technological sense, should be deprived of their right to the title. The meeting showed a healthy sign of activity among chemists, and it should produce far reaching results. We trust that the Institute of Chemistry will welcome the opportunity of developing its sphere of usefulness. There is much to be considered and much to be done yet to secure for British chemists the position and recognition to which by their work they are clearly entitled.

THE death is announced, while leading his platoon during one of the recent advances in France, of 2nd Lieut. F. Entwistle, second assistant at the Observatory, Cambridge, aged twenty-one years. Mr. Entwistle was a computer at the Royal Observatory, Greenwich, and he went to Cambridge as second assistant in December, 1914. He was there a few months only before he was given a commission in the Norfolk Regiment as 2nd Lieutenant. Mr. Hartley, first assistant at the Cambridge Observatory, was killed on the *Vanguard* on July 9. The double tragedy exhausts the staff of the observatory, as distinct from the Solar Physics Observatory, except for the director.

MR. F. N. HAWARD, writing from 95 Uxbridge Road, Ealing, W.5, points out that the late Mr. Worthington G. Smith, whose work was referred to in NATURE of November 8, p. 191, was not only a botanist, but had also a world-wide reputation as an antiquarian. "W. G. S. was one of the most practical authorities in matters relating to prehistoric man, of whose implements of flint he made many discoveries of great importance. Besides being the author and illustrator of such a classic as 'Man, the Primeval Savage' (1894), he contributed largely and wisely to the current literature of the subject, and, being an expert engraver, he illustrated many of the works of his contemporaries on various scientific matters."

MR. J. A. HARDCASTLE, whose death on November 10 we much regret to record, was a grandson of Sir John Herschel, and himself a very capable astronomer in the fourth generation of that illustrious race of scientific men. Always a man of delicate health, and obliged in early manhood to winter abroad, he had been able by care and courage to carry through several important pieces of work in the intervals of illness, and the friends who had the privilege of knowing him recognised how considerable a share of the family talent was his. About fourteen years ago he undertook the measurement for the late Mr. S. A. Saunder of a series of lunar negatives from the Paris and Yerkes Observatories, which formed the observational basis of the now classic catalogue of precise positions on the moon's surface. Never, perhaps, in the history of observational astronomy has there been a more striking improvement on previous results than was shown in this work, and Mr. Saunder was always insistent on giving to Mr. Hardcastle a large part of the credit for his remarkable skill and judgment in a difficult task. A second large piece of work that he carried to a successful end was the examination and classification of the nebulæ on the 210 plates of the Franklin-Adams photographic chart of the whole sky, the results of which are published in the Monthly Notices of the Royal Astronomical Society for June, 1914. This has the unique merit that it is the only examination of the nebulæ of the whole sky made with the same instrument and of approximately uniform standard. For a number of years Mr. Hardcastle was a very successful University Extension lecturer in astronomy; he had served as secretary of the British Astronomical Association, and as member of council of the Royal Astronomical Society. A few months ago he was appointed to succeed Dr. Dreyer as director of the Armagh Observatory, and was looking forward with the keenest pleasure to the enjoyment of better health and the responsibilities of an official post, when a return of illness disappointed his hopes, and he died after much suffering at the early age of forty-nine.

THE Royal Geographical Society has sustained a deplorable loss in the death of one of its most active and most valued supporters, Brig.-Gen. Cecil Rawling, C.M.G., one of the gold medallists of the society this year. Many famous names are to be found in the list of soldier-geographers who have made exploration the one great objective of their lives, but there is not one which recalls a personality more inspired with high ideals or better endowed with all those qualities of mind and body which are the necessary outfit for the true explorer than Rawling. His best contributions to geographical science were gathered in Tibetan fields. He was there responsible for the results of an expedition in 1897-98 which added considerably to our knowledge of about 40,000 square miles of that inhospitable country. Such an experience fitted him well for the leadership of a subsequent expedition which was planned, after the Tibetan campaign under Sir F. Younghusband, for the determination of the sources of the Brahmaputra and Indus. Col. Ryder was attached to the expedition as surveyor, and brought back excellent mapping of the wild districts bordering the great Tibetan high road between Gartok and Lhassa, but the success of the expedition was doubtless due to the

remarkable capacity of its leader. Rawling's last expedition, to New Guinea, whilst it was not productive of all the geographical information which was anticipated, was nevertheless a most valuable pioneer exploration into an utterly unknown region, and proved to be of the highest interest to many collateral branches of science which depend on geographical discovery as their preliminary basis. It was fitting perhaps that a right good soldier and a famous explorer should meet his end in the field of a war waged in the interests of all humanity. Like Toppin (of the Peru-Bolivian boundary), who died at Mons, he never lived to reach his highest ideal. That ideal with Rawling was nothing less than the ascent of Everest, and who shall say that a man of his stout heart and magnificent physique would not have accomplished what many men have pronounced to be an impossibility?

THE Royal Society announces that the King has approved of the award by the president and council of the society of a Royal medal to Dr. John Aitken, for his researches on cloudy condensations, and a Royal medal to Dr. Arthur Smith Woodward, for his researches in vertebrate palæontology. The following awards have also been made by the president and council:—The Copley medal to M. Emile Roux, for his services to bacteriology and as a pioneer in serum therapy; the Davy medal to M. Albin Haller, for his researches in the domain of organic chemistry; the Buchanan medal to Sir Almroth Wright, for his contributions to preventive medicine; and the Hughes medal to Prof. C. G. Barkla, for his researches in connection with X-ray radiation.

IT has been decided to dissolve the Société Internationale de Chirurgie, and to form, after the war, a new society on the lines of the former one, but to be called the Société Interalliée de Chirurgie, the membership of which will be open not only to surgeons of the Allied countries, but also to those of neutral countries who shall be nominated for election by the general committee.

AT the annual general meeting of the Cambridge Philosophical Society held on October 29 the following were elected officers of the society for the ensuing session:—*President*, Prof. Marr; *Vice-Presidents*, Prof. Newall, Dr. Doncaster, and Mr. W. H. Mills; *Treasurer*, Prof. Hobson; *Secretaries*, Mr. A. Wood, Mr. G. H. Hardy, and Mr. H. H. Brindley; *New Members of Council*, Sir J. Larmor, Prof. Eddington, and Dr. Marshall.

THE council of the Institution of Civil Engineers has made the following awards for papers published in the Proceedings without discussion during the session 1916–17; A Watt gold medal to Major H. S. B. Whitley (Neath); Telford premiums to W. C. Popplewell (Manchester), H. Carrington (Woodley, Stockport), Dr. A. A. Stoddard (Bournemouth), A. E. L. Chorlton (Lincoln), and B. M. Samuelson (Rangoon); the Manby premium to R. Bleazby (Perth, W.A.); the Webb prize to J. B. Ball (London); and the Howard Quinquennial prize to Dr. W. C. Unwin.

AT the anniversary meeting of the Mineralogical Society, held on November 6, the following were elected officers and ordinary members of council:—*President*, Mr. W. Barlow; *Vice-Presidents*, Prof. H. L. Bowman and Mr. A. Hutchinson; *Treasurer*, Sir William P. Beale, Bart.; *General Secretary*, Dr. G. T. Prior; *Foreign Secretary*, Prof. W. W. Watts; *Editor of the Journal*, Mr. L. J. Spencer; *Ordinary Members of Council*, Mr. T. V. Barker, Mr. G. Barrow, Prof. C. G. Cullis, Mr. F. P. Mennell, Mr. H. Collingridge, Mr. T. Crook, Dr. G. F. Herbert Smith, Dr. H. H. Thomas, Mr. H. F. Collins, Mr. J. P. De Castro, Prof. H. Hilton, and Lieut. Arthur Russell.

THE programme of the one hundred and sixty-fourth session of the Royal Society of Arts, to be opened on Wednesday, November 21, shows that the society is continuing its valuable work for "the advancement, development, and practical application of every department of science in connection with the arts, manufactures, and commerce of this country." At the opening meeting an address will be delivered by Mr. Alan A. Campbell Swinton, chairman of the council, upon "Science and its Functions." At a later meeting the general aspects of the application of science to industry will form the subject of a lecture by Sir Dugald Clerk, and during the session leading authorities will deal with particular industries, such as those of sugar, rubber planting, cotton, timber, and the manufacture of margarine in Great Britain. Some of the papers to be read after Christmas are:—The relations between labour and capital, Lord Leverhulme; The war and its effects on the mind, Sir Robert Armstrong-Jones; Water-power in the British Isles, A. Newlands; Agricultural machinery, F. S. Courtney; and Organic chemistry in relation to industry, Dr. M. O. Forster. The Cantor lectures will include courses on progress in the metallurgy of copper; high-temperature processes and products; and military explosives of to-day.

THE Postmaster-General, speaking at the Mansion House on November 12, said:—"It is intended, as soon as the military position will admit, to institute international aerial posts between London and the various principal capitals of Europe."

MR. A. ADAMS, writing from Looe, Cornwall, records the occurrence in that county of the little owl (*Carine noctua*). A specimen was sent to him recently for identification by a rabbit-trapper in the neighbourhood, who had found it in a trap. In the *Zoologist*, in 1914, the little owl was recorded as breeding in Somerset; Mr. Adams's communication shows that it has extended its range westwards and southwards, as one would expect.

MR. T. MCKENNA, chairman of the Executive Committee of the Decimal Association, informs us that at a recent joint meeting of the association with the Institute of Bankers and the Association of Chambers of Commerce unanimous agreement was secured as to the retention of the £ sterling as the monetary unit and its division into 1000 parts, or mils. This enables all the existing gold and silver coins down to and including the sixpenny-piece to be retained without any alteration in their respective values. For example, the sixpence is represented exactly by 25 mils. In regard to the coins of lower denomination, it was unanimously agreed that they should consist of 1, 2, 3, 4, 5, and 10 mil pieces, of which the two latter would be of nickel. This enlarged range of the coins of lower value, in addition to providing coins substantially equal in value to the existing halfpenny and penny, would provide coins of intermediate value between the present halfpenny and penny, and thus overcome a defect in our present coinage which has resulted in prices in millions of small transactions in daily life being unduly increased because of the absence of suitable intermediate coins.

OWING to ill-health Dr. R. Hamlyn-Harris, director of the Queensland Museum, resigned his appointment on September 30. Referring to his retirement, the *Brisbane Courier* remarks that it will be a serious loss to the institution and to the cause of science in Queensland. It is about seven years since Dr. Hamlyn-Harris was appointed director, and in the interven-

ing period he has laboured with enthusiasm and ability to make the museum an educational force in the community. He succeeded in making the museum both attractive to non-scientific visitors and a centre of student and scientific activity. He raised the scientific status of the institution, and reorganised the whole of the valuable collections, and the fine ethnological department of the museum owes a great deal to his knowledge, study, and enterprise.

THE Admiralty has issued the following particulars of the unmanned, controlled high-speed craft to which we referred last week (p. 190):—The electrically controlled motor-boats used on the Belgian coast are twin petrol-engined vessels partially closed in, and travel at a high speed. They carry a drum with between thirty and fifty miles of insulated single-core cable, through which the boat is controlled electrically. The fore part carries a considerable charge of high explosive, probably from 300 lb. to 500 lb. in weight. The method of operating is to start the engine, after which the crew leave the boat. A seaplane, protected by a strong fighting patrol, then accompanies the vessel at a distance of three to five miles, and signals to the shore operator the helm to give the vessel. These signals need only be "starboard," "port," or "steady." The boat is zigzagged while running; this may be either intentional or unintentional. On being steered into a ship the charge is exploded automatically. The device is a very old one. A boat similarly controlled was used in H.M.S. *Vernon* (the torpedo experimental ship) so far back as 1885. The only new features in the German boats are petrol engines and wireless telegraphy signals, neither of which existed then.

THE first report of the Conjoint Board of Scientific Societies shows that many subjects of national importance have engaged the attention of the board since it was constituted in June of last year. Forty-eight leading scientific and technical societies are represented upon the board, and the expenses are met by contributions from them. The receipts at the end of September last amounted to 652*l.* 6*s.* 8*d.*, the expenses to 270*l.* 12*s.* 3*d.*, and the balance at that date was 381*l.* 14*s.* 5*d.* There are ten sub-committees concerned respectively with the International Catalogue of Scientific Literature, the application of science to agriculture, technical optics, education, the prevention of overlapping among scientific societies, the metric system, anthropological survey, iron-ore, the water-power of the Empire, and timber for aeroplane construction. The Sub-committee on Agriculture emphatically believes that a great future awaits the development of electrical applications to agriculture in the United Kingdom. The board recommends, therefore, that the Board of Agriculture be asked to grant the necessary funds for designing, constructing, and testing practically an electrical tractor and certain other agricultural machines. The Sub-committee on Education, in conference with representatives of the Council of Humanistic Studies, has arrived at a reasonable statement as to the essential place of science in education. It has also communicated to Sir Joseph Thomson, for the use of the Government Committee on Science in the Educational System of Great Britain, two resolutions referring to the importance of training teachers to give inspiring and attractive courses in science, and the need for adequate salaries to be paid to such teachers. Dr. G. W. Walker having stated that in working on the magnetic survey of the country he had found evidence of disturbance in certain areas which he considered might be explained by the presence of iron ores, the board, upon the recommendation of the Iron-ore Sub-committee, has arranged for a detailed magnetic survey of (1) the neighbourhood of Melton Mowbray, and (2) that of Strachur and Lochgoilhead. The survey will be accompanied by (1) a detailed geological and petrological investigation of the rocks in each area, and (2) a determination of the magnetic permeability of the rocks and minerals occurring in each area. The report refers, among other matters, to the establishment of the Department of Scientific and Industrial Research, of the Department of Technical Optics at the Imperial College, and proposals by the British Association for the formation of a Geodetic Institute, with which the board has expressed itself entirely in sympathy.

UNDER the title of "Links between North and South," Prof. Flinders Petrie, in the October issue of *Man*, traces a connection between the Teutonic goddess Brynhild and Ishtar of Babylon. "The position seems to be that a warrior goddess, with lovers, but never married, who forced her way into hell, was an idea of a Central Asian people; that this was transformed into Ishtar by the peoples who pressed down in prehistoric days into Babylonia; that it was carried in some form westward by the Huns, and transformed into Brynhild by the Norse ethics and customs; and it was finally treated by the Germans much as Malory treated the Arthurian legends. Such are a few of the dim links between North and South which may some day serve to join up the two great streams of ancient history."

THE second number of "Recalled to Life" was issued in October. It is a journal devoted to the care, re-education, and return to civil life of disabled sailors and soldiers, and contains valuable matter dealing with treatment and training and with administrative matters such as pensions. In the present number Col. Sir John Collie discusses neurasthenia and allied disorders, Major Horton-Smith Hartley deals with tuberculosis in its relation to the war, and Sir William Osler offers some remarks on the problem of the crippled.

THE method of determining the surface tension of a liquid in air by allowing drops of the liquid to form slowly at the lower end of a thick-walled capillary tube and counting the number which fall off is so simple that it is very unfortunate that a satisfactory theory of the process has never been given. Lord Rayleigh showed that the mass m of the drop of a liquid of surface tension T which falls from a tube of outer radius r is given by $mg=CTr$, where C is a constant which varies from 3·7 to 4·2, according to the properties of the liquid and the radius of the tube. The problem is a dynamical one, and its ultimate solution will be facilitated by the recent kinematograph pictures of the formation of falling drops which have been taken for M. F. L. Perrot, and are reproduced in his article on the subject in the *Revue générale des Sciences* for October 15. They show that the drop before it breaks away is connected to the liquid above it by a thin filament of considerable length, which breaks simultaneously in two places. We hope M. Perrot will succeed in placing the method on a sound basis.

THE following works are in preparation for appearance in Messrs. Longmans and Co.'s *Monographs on Physiology*:—"The Physiology of Reflex Action," Prof. C. S. Sherrington; "The Physiological Basis of the Action of Drugs," Dr. H. H. Dale; "The Nature of Muscular Movement," Dr. W. M. Fletcher; "The Cerebral Mechanisms of Speech," Dr. F. W. Mott; "Tissue Respiration," Dr. C. Lovatt Evans; "The Physiology of Muscular Exercise," Prof. F. A. Bainbridge; and "The Vaso-Motor System," Prof. W. M. Bayliss.

OUR ASTRONOMICAL COLUMN.

NOVEMBER METEORS.—The moon being absent this year at the epoch of the Leonids, a favourable opportunity will occur, should the atmosphere be clear, for re-observing the shower. The parent comet (Tempel 1866 I.) is, however, now near aphelion, and there is little prospect of witnessing an abundant display. But some of the swift, streaking meteors directed from the "Sickle of Leo" are visible every year, and may well repay observation on the morning of November 16.

There is another shower, possibly more irregular and uncertain in its returns, connected with Biela's comet. These meteors, radiating from near γ Andromedæ, travel very slowly, as they are moving in the same direction as the earth and have to overtake us. They are due on the nights from November 19 to November 22, and may be observed at any hour. These Andromedids were seen in 1872, 1885, 1892, 1899, and 1904, but have not reappeared in plentiful numbers since the last-named year. The parent comet has not been seen since 1852, though it must have made nine returns to perihelion, the periodic time being about 6·6 years.

ENCKE'S COMET.—It is curious that although this comet was photographed a year ago, when close to its aphelion, yet repeated search in the present autumn has failed to reveal it. The object observed for it in mid-September by Wolf proves not to be a comet, but a minor planet. It has been designated CP, and the following orbit published:—

Epoch 1917 October 3·5 G.M.T.

$$\begin{array}{llll} \mathrm{M.} & 29^\circ\ 5{\cdot}6' & & \phi\ \ 11^\circ\ 30{\cdot}4' \\ \omega & 39^\circ\ 44{\cdot}2' & \multirow{3}{*}{\left.\begin{array}{l}\\ \\ \\ \end{array}\right\} 1917{\cdot}0} & \mu\ \ 1057{\cdot}9'' \\ \Omega & 285^\circ\ 43{\cdot}7' & & \log a\ \ 0{\cdot}35038 \\ i & 4^\circ\ 43{\cdot}7' & & \text{Period } 3{\cdot}354\text{ y.} \end{array}$$

It will be recalled that in January, 1908, Prof. Wolf announced an object as Encke's comet that proved to be an independent comet. The very large value 3·84 was found for its perihelion distance, but the observations were too few to give trustworthy elements.

EFFECTIVE WAVE-LENGTHS OF CLUSTERS AND SPIRAL NEBULÆ.—A new series of determinations of the effective wave-lengths of certain spiral nebulæ and globular clusters has been made at Upsala by K. Lundmark and B. Lindblad (*Astronomische Nachrichten*, 4907). The method employed was that in which a coarse grating, with spacing in this case of 1·3422 mm., is fixed in front of the object-glass of a photographic telescope. Some of the results are as follows:—

Object		Mag.	Effective wave-length
Cluster	M5	6·7	4191
,,	M3	6·6	4251
Spiral	M94	7·7	4267
,,	M51	8·4	4307
,,	M64	8·6	4338

A FAINT STAR AS NEAR AS α CENTAURI.—In Circular No. 30 of the Johannesburg Observatory attention was directed by Mr. Innes to a faint star in Centaurus which had been found to have the large proper motion of about 5″ per annum. Mr. J. Voûte, of the Cape Observatory, now announces (Monthly Notices, R.A.S., vol. lxxvii., p. 650) that the parallax and proper motion of this star are nearly identical with those of α Centauri, which is still the nearest star known. Mr. Voûte finds the parallax to be 0·755″, and the proper motion 3·76″ in the direction 282·7°, while the corresponding figures for α Centauri are 0·759″, and 3·68″ in the direction 281·4°. It will be seen that the agreement is extraordinarily close, although the distance between the two stars is 2° 12′. The question is raised as to whether the stars are physically connected, or are members of the same drift.

The visual and photographic magnitudes of the faint star are respectively 11·0 and 13·5, so that the spectrum is probably of type M. The magnitude reduced to a distance of 10 parsecs is 15·4, or 17·9 photographically, and the star would thus appear to be the faintest at present known.

The position of the star for 1916·11 is R.A. 14h. 23m. 54·28s., declination −62° 19′ 10·1″.

PYROMETERS AND PYROMETRY.

THE meeting of the Faraday Society on November 7, at the Royal Society of Arts, Sir Richard Glazebrook occupying the chair, was devoted to a general discussion on "Pyrometers and Pyrometry." From the character of the papers read and the remarks of the various speakers, it may be inferred that present-day activities in this direction are mainly devoted to applying existing instruments to industrial uses, rather than to the development of new methods of measuring high temperatures. The extent to which pyrometers are now employed may be gauged from the fact that one armament firm alone has six hundred instruments in daily use, and in all branches of industry where accurate temperature control is necessary pyrometers now form an indispensable part of the equipment.

In this country the standardisation is undertaken by the National Physical Laboratory. At the outbreak of the war negotiations were in progress with a view to the production of an international scale of temperatures, in the absence of which a provisional scale has been adopted for present purposes. Dr. Ezer Griffiths and Mr. F. H. Schofield, on behalf of the N.P.L., gave an account of this scale, and also of the methods adopted in standardising pyrometers of various types. A striking confirmation of the value of central standardisation was furnished later in a paper read by Prof. J. O. Arnold, who, in experiments on the quenching of high-speed steels, used four different types of pyrometers to control the temperature of a barium chloride bath. The agreement of the instruments near to 1300° C. was remarkably good, and proved that any of the four could have been relied upon to regulate the temperature independently.

The types of pyrometers now used industrially are chiefly the thermo-electric, for temperatures up to 1200° C., and total radiation and optical pyrometers for higher temperatures. The chief drawback to the thermo-electric instrument is the error caused by fluctuations in the temperature of the cold junction, to obviate which various devices have been introduced from time to time. Mr. R. S. Whipple suggested that this trouble might be overcome by burying the cold junction in the ground to such a depth that any temperature variations would be negligible. From experiments conducted at Cambridge, and extending over three years, it was found that at a depth of 10 ft. the variation in temperature was only 1·6°. It was pointed out, however, that in the vicinity of a group of steel furnaces it would be necessary to locate the cold junction at a much greater depth than 10 ft. to secure anything approaching constancy, and that in consequence the method would have a limited application in practice. With regard to optical pyrometers, it was rather disquieting to learn that the monochromatic glass used in some of these instruments could not yet be produced in England. Pre-war supplies were of German origin, and at present this indispensable material is obtained from the United States. It is to be hoped that one of our own glass firms will take this matter in hand, particularly in view of the rapid extension of the use of optical pyrometers.

Several of the papers read bore on the temperature of molten steel, and the discussion made it clear that steel-makers now attach great importance to the tem-

perature at which steel is poured, as the properties of the ingot produced are influenced by this factor. The correct measurement of this temperature is difficult; thus, if an optical pyrometer be sighted on the molten stream as it issues from the furnace, black-body conditions are not realised, and the apparent temperature indicated may vary according to the quantity of slag accompanying the metal. Similarly, the layer of cooled slag on the surface of the metal in the ladle prevents the true temperature from being ascertained by optical means. Although an occasional reading may be taken with a sheathed junction of platinum and platinum-iridium alloy, the method could not be used regularly owing to the rapid destruction of the sheath. One proposal made was to encase the wires in a large mass of fireclay, leaving the ends uncovered, so that both touched the molten steel; but it was pointed out that this method would cause a rapid destruction of the wires. In spite of these difficulties much progress has been made by following out definite lines of procedure, such as sighting on a certain part of the molten stream at definite intervals of time during the pouring. Mr. Cosmo Johns and others found it possible, under uniform conditions, to obtain readings varying only by 5° to 10°, which, as the chairman remarked, was a surprising result considering the temperature measured. All the speakers who had attacked this problem agreed that the temperature of open-hearth steel when being poured was about 1600° C., careful determinations by Dr. Hatfield with a thermal junction indicating 1600° to 1625°. Further work in this direction is very desirable, as a trustworthy method would be of the greatest value to the steel-maker.

It is still customary in the pottery industry to gauge the firing temperature by using a set of clays of progressive fusibility, and noting the effects on the separate pieces. The latest developments of this method were described in the paper read by Mr. H. Watkin, one of which consisted in placing the test-pieces across two sloping uprights, ladder fashion, so that the droop or complete fusion of any could be readily observed.

Two new suggestions for measuring temperatures of the nature of 1600° C. were put forward, both of which entailed the use of a fused metal. Dr. Northrup, of Trenton, U.S.A., described an instrument based on the expansion of molten tin, constructed on the same lines as an ordinary thermometer. The bulb and stem were of graphite, and a nickel wire passing through a gland in the top of the stem could be pushed down so as to touch the top of the molten tin, when an electric circuit was completed. The position of the top of the column of tin in the stem could thus be ascertained and the stem divided up in the same manner as a thermometer. Dufour many years ago suggested a thermometer of tin in a silica envelope, but the instrument never came into practical use, and the graphite enclosure is an undoubted improvement. Dr. Northrup has found that molten tin does not give off vapour at 1700° C., and proposes to use his instrument up to this or even higher temperatures. Mr. C. R. Darli[illegible] suggested a thermo-electric pyrometer in which one or both of the members of the couple might melt without breaking the circuit. As shown by Mr. A. W. Grace and Mr. Darling, the thermo-electric properties of metals in general are unchanged by fusion, and hence cheap metals, such as tin or copper, might be used to [illegible] temperatures of 1500° C. or more, as their boiling points usually exceed 2000° C.

An excellent feature of the meeting was an exhibition in the room of pyrometric apparatus of all kinds. Included in these was the original tapered gauge u[illegible]y Josiah Wedgwood for measuring the contraction of his clay cylinders, by means of which the science of high-temperature measurement was founded. The modern productions of British makers are highly satisfactory, and this young but flourishing industry has undoubtedly a great future in front of it. Special mention may be made of an automatically controlled furnace, on the principle devised by Mr. R. P. Brown, of Philadelphia. The control is effected by means of a thermo-electric pyrometer inserted in the furnace, the indicator of which is provided with two stops, which may be set in any position, one on either side of the pointer. To control a furnace to within 5° above or below a given temperature, the stops are set at 5° on either side of the number on the indicator. The pointer of the indicator is depressed periodically by means of clockwork, and when touching either stop an electric circuit is completed which actuates a relay. If touching the lower stop, the effect is to cut out an external resistance from an electric furnace, or to open wider the tap of a gas supply in a gas furnace, whilst when in contact with the higher stop resistance is added or the gas supply checked. There appears to be no good reason why large furnaces should not be similarly controlled, and the saving in fuel and labour effected should soon cover the cost of the apparatus.

The success of the discussion, in which makers of pyrometers, representatives of various industries, and scientific men were able to compare notes, suggests that meetings of this kind are desirable in connection with the application of science to manufacturing processes, and cannot fail to act as a stimulus to all concerned.

HEREDITARY CHARACTERS IN RELATION TO EVOLUTION.[1]

II.

(1) FIRST, then, what are the facts as to numerous finely graded variations in a single unit factor? Here we have certain remarkable data as to the eye-colour of Drosophila—data that are of great interest with relation to the nature of evolutionary change. This fruit fly has normally a red eye. Some years ago a variation occurred by which the eye lost its colour, becoming white, a typical mutation. Somewhat later, another variation came, by which the eye colour became eosin. By those wonderfully ingenious methods which the advanced state of knowledge of the genetics of Drosophila have made possible, it was determined that the mutations white and eosin are due to changes in a particular part of a particular chromosome, namely, of the so-called X-chromosome, or chromosome I. And further, it was discovered that the two colours are due to different conditions of the same *locus* of the chromosome; in other words, they represent two different variations of the same unit. Moreover, the normal red colour represents a third condition of that same unit. And now, with the minute attention paid to the distinction of these grades of eye colour, new grades begin to come fast. Up to date we know from the mutationists' own studies of Drosophila that a single unit factor presents seven gradations of colour between white and red, each gradation heritable in the usual Mendelian manner. These grades are the following:—(1) red; (2) blood; (3) cherry; (4) eosin; (5) buff; (6) tinged; (7) white. Considering that the work on Drosophila has been going on only about seven or eight years, this is [illegible]rogress toward a demonstration that a [illegible] unit factor can present as many grades as can be distinguished; that the grades may give a pragmatically continuous series. The extreme selectionist asks only a little more than this.

Besides showing that a unit factor may thus exist in numerous minutely differing grades, this case shows

[1] Abridged from an address by Prof. H. S. Jennings. Continued from p. 198.

that a heritable variation may occur so small as to be barely detectible. Although the variations do not usually occur in this way, the case presents the conditions which would allow of a gradual transition from one extreme to the other, by means of numerous intermediate conditions. In a population in which were occurring such minute changes as are here shown to be possible, we could get by selection such a continuous series of gradations as Castle describes in his rats.

(2) But, as we have seen, the mutationists reject the view that the changes in the coat colour of the rat are due to alterations in a singe unit factor; they explain this and other cases of the effectiveness of selection on a single character by *multiple modifying factors*. Accepting again their contention, the question is shifted to the nature of such factors.

Our direct experimental knowledge of these "modifying factors" is scanty. We find data as to certain known modifying factors by one of the workers on Drosophila, Bridges (1916), in his recent important paper on non-disjunction of the chromosomes.[7] Bridges found a factor the only effect of which was to lighten the eosin colour in a fly with eosin eyes; this factor, indeed, nearly, or quite, turns the eosin eye white. Another factor has the effect of lightening the eosin colour a little less, giving a sort of cream colour. A third factor dilutes the eosin colour not so much. In addition to these, Bridges has discovered *three other* diluters of the eosin colour, and another factor the only effect of which is to modify eosin in the direction of a darker colour. None of these factors has any effect save on eosin-eyed flies. These things add tremendously to our gradations in eye colour. We had already been furnished seven grades, from white to red; now we have seven secondary grades within a single one of these seven primary grades. These seven new grades are not located in the same unit factor as are the seven primary ones; their loci are in other chromosomes (or possibly in other parts of the same chromosome).

Here again, then, we have minutely differing conditions of a single shade of colour, brought about by seven modifying factors. Bridges makes the following remark concerning them:—

"A remarkably close imitation of such a multiple case as that of Castle's hooded rats could be concocted with the chief gene eosin for reduced colour, and these six diluters which by themselves produce no effect, but which carry the colour of eosin through every dilution stage from the dark yellowish pink of the eosin female to a pure white."[8]

Now this is an extremely interesting statement, one that must arouse the keen interest of the student of the method of evolution. In Drosophila we could get the same sort of graded results that Castle does with his rats, only in Drosophila this is by means of multiple modifying factors, whereas Castle believes that in the rat it is by actual alterations of the hereditary constitution!

But what are these modifying factors? And here we come to the astonishing point. *These modifying factors are themselves alterations in the hereditary constitution.* Bridges leaves no doubt upon this point. He lists and describes them specifically as mutations; as actual changes in the hereditary material.

Where, then, is the difference in principle between the condition in Drosophila and that in the rat? In Drosophila there occur minute changes in the germinal material, such as to give, so far as our present imperfect knowledge goes, seven diverse grades of a colour which is itself only one grade of another series of seven known grades. By means of these graded changes one could obtain, by the mutationist's own statement, the continuously graded results which selection actually gives. What more can the selectionist ask?

The mutationist thinks of all these numerous grades as, after all, essentially discontinuous, as a series of steps so minute that the difference between one and the next one is not detectible. His opponent, on the other hand, perhaps thinks of the series as actually continuous. But when steps become so minute as to be beyond detection, the question whether they exist becomes metaphysical.

To put the case in brief, if the mutationists are to show that the existence of multiple modifying factors has any bearing on the general question of the effectiveness of selection, they must show that such factors are not themselves minute changes in the hereditary constitution. Not only have they made no attempt to do this, but in the only well-examined cases they state squarely that such factors are indeed alterations in the hereditary constitution.

For the inheritance of such factors as Mendelian units, of course absolutely nothing is required save that the location of the change is in a chromosome. No particular degree of magnitude, no unity of any other kind is required.

But there remains one point brought out by the mutationists which is of great importance to the student of the method of evolution. While they must admit, by their own account, that all these grades occur, they, of course, point out that the changes do not occur in a continuous series. In the eye of Drosophila variation may occur from red to white directly, without any transitional stages; or from any grade to any other; the continuous scale is obtained only by arranging the steps in order. Therefore, it is maintained, evolution may have occurred by such large steps, not by continuous gradations.[9] This is, of course, a matter deserving of serious consideration. But certain other points must be considered also. First, the very facts known for Drosophila show that there is nothing to prevent a passage from one extreme to the other by minute changes, just as is held to occur by the palæontologists and selectionists, although change by large steps occurs also. Secondly, in such cases as the eye colour of Drosophila we are dealing with characters that are already highly developed. We know, for example, that this particular character is formed by the co-operation of many separate parts of diverse chromosomes; it is a highly complex product of evolution. Now, we find that one or another of these parts may suddenly cease to perform its function, so that the red colour is not completely formed; there is a sudden change in it; or it may disappear entirely. But is this, after all, strong evidence that in the original production of this complex character with its numerous underlying functional parts, there was the same change by sudden large steps? Indeed, is it not rather true that such destructive changes in a fully formed character could not be expected to throw light on how that character was built up?

To sum up, it appears to me that the work on Drosophila is supplying a complete foundation for evolution through selection of minute gradations. The so-called "multiple allelomorphs" show that a single unit factor may thus exist in a great number of grades; the "multiple modifying factors" show that a visible character may be modified in the finest gradations by alterations in diverse parts of the germinal apparatus. The objections raised by the mutationists to gradual change through selection are breaking down as a result of the thoroughness of the mutationists' own studies. The only outstanding difficulty is the

[7] Bridges, 1916, p. 148. (See Bibliography.)
[8] *Ibid.*, p. 149. (See Bibliography.)
[9] See particularly the discussion of this point in Morgan, 1916, pp. 7–27. (See Bibliography.)

fact that large changes occur as well as small ones; this seems perhaps due to the fact that we are witnessing the disintegration of highly developed apparatus in place of its building up.

In all this, except the last point, the work on Drosophila is in agreement with my own observation of gradual variation in Difflugia, with Castle's similar results on the rat, and with the conclusions of palæontologists as to the gradual development of the characteristics of organisms in past ages.

But there is one point in the palæontological conclusions which is not in agreement with the experimental and observational results on existing organisms; this I wish to notice briefly. Osborn sets forth that in following given stocks from earlier to later ages, characters arise from minutest beginnings, and pass by continuous gradations to the highly developed condition; these developing characters do not show random variations in all directions, but follow a definite course, which might seem to have been in some way predetermined. And this is emphasised by the fact that the same sorts of characters (horns, for example) may arise independently, at different ages, in diverse branches of the same stock, and each follow in later ages the same definite course of development. Evolution is characterised by Orthogenesis, as this phenomenon has sometimes been called.

Now it appears to me that we do not observe this in the present-day experimental work; by selection we can move in more than one direction. There is no indication, so far as I can see, that the variations push in one determinate direction only. Examining the palæontological summaries further as regards this, we find that diverse courses are followed by given characters, in diverse branches of a given group.

A second point which Osborn sets forth is deserving of particular attention. He states, in agreement with Waagen, that in any given geologic stratum, we do find, in addition to characteristics that are in the line of determinate descent, other variations from this line, which are of the sort that constitute what we call at the present time varieties; things that are like the diverse races of Difflugia in my own work. But, say Osborn and Waagen, there is a great difference in principle between these and the others, for those which are in the determinate line of progress persist into the next geologic stratum, while the mere varieties do not. The persistent changes were called by Waagen mutations (in a sense somewhat diverse from that in which the word is used by de Vries).

Osborn expresses the opinion that these "varieties" may be merely non-heritable modifications.[10] But in our present geologic period we find just such diverging forms, in great number, and we find that their peculiarities *are* heritable. There is, then, no reason for supposing that these variations were not heritable in earlier geological periods; there must have been many races heritably diverse, just as there are now; and these are what Waagen called varieties.

Now, since this is so, the only difference between Waagen's mutations and his varieties is that the former persisted and the latter did not. But this tells us nothing whatever about why the latter did not. It is perfectly possible, so far as these facts go, that it was a matter of selection by external conditions; many diverse stocks were present, on an equal footing; some were destroyed, others were not. The conditions described by the palæontologists support strongly the theory of evolution by gradual change, but I cannot see that they tend to establish the view that variations show a tendency to follow a definite course, as if predetermined. The palæontologists appear rather to report precisely the conditions which we are bound find if evolution occurs through the guidance of natural selection operating on a great number of diverse variations, the typical Darwinian scheme.

There is one other point, made by Bateson (1914), in his presidential address before the British Association, and further developed by Davenport (1916) in a recent paper: the proposition, namely, that since practically all observed variations are cases of loss and disintegration, we are driven to suppose that evolution has occurred by loss and disintegration. Davenport combines this idea with the theory that these disintegrating variations follow a definite course, predetermined in large measure by the constitution of the disintegrating material.

There are two points worth consideration in dealing with this theory. The first is one of fact; although it is true that many of the so-called mutations appear to be cases of loss and disintegration, yet there is no indication that this is the case in such effects of selection as have been described by Castle and myself; variations are not limited to any particular direction. Secondly, it appears to me that this conclusion—that because the variations we see are cases of loss and disintegration, therefore evolution must have occurred by loss and disintegration, involves an error in logic, which makes it unworthy of serious consideration.

To summarise, then, what I have obtained from experimental work combined with a survey of the work of others, the impression left is as follows:—

(1) Experimental and observational study reveals that organisms are composed of great numbers of diverse stocks differing heritably by minute degrees.

(2) Sufficiently thorough study shows that minute, heritable variations—so minute as to represent practically continuous gradations—occur in many organisms, some reproducing from a single parent others by biparental reproduction.

(3) The same thing is reported from palæontological studies.

(4) On careful examination we find even that the same thing is revealed by such mutationist work as that on Drosophila; single characters exist in so many grades due to minute alterations in the hereditary constitution as to form a practically continuous series.

(5) It is *not* established that heritable changes must be sudden large steps; while these may occur, minute heritable changes are more frequent.

(6) It is *not* established that heritable variations follow a definite course as if predetermined; they occur in many directions.

(7) It is not established that all heritable changes are by disintegration; although many such do occur, they cannot be considered steps in progressive evolution from the visibly less complex to the visibly more complex.

Evolution according to the typical Darwinian scheme, through the occurrence of many small variations and their guidance by natural selection, is perfectly consistent with what experimental and palæontological studies show us; to me it appears more consistent with the data than does any other theory.

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UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is proposed by the governors of the West Ham Municipal Central Secondary School to call the institution "The Lister School," to perpetuate the association of Lord Lister with the borough of West Ham.

The annual meeting of the Association of Public School Science Masters will be held on Tuesday and Wednesday, January 8 and 9, at the City of London School, under the presidency of Sir Ronald Ross, who will give an address on "Observations on the Results of our Present System of Education." The subjects to be discussed during the meeting are:—Examination or inspection as a test of science teaching, G. F. Daniell; Compulsory science in university entrance examinations, O. H. Latter; Subsidiary subjects in university scholarships examinations, H. de Havilland; Descriptive astronomy in the "science for all" course, Rev. A. L. Cortie; and Map reading as a school subject, V. S. Bryant.

A SCHOLARSHIP designated the "Institution of Naval Architects Scholarship in Naval Architecture" will be offered for competition among students of the institution in 1918. All students (being British subjects) who have been elected at or before the annual general meeting of the institution (March 20, 1918) will be eligible for this scholarship, subject to the conditions named below. The scholarship is of the annual value of 100*l.*, and is tenable for three years, provided that they are not less than eighteen or more than twenty-one years of age on March 1, 1918, and at that date have been continuously employed for at least two years upon naval architecture or marine engineering. Candidates for the scholarship must forward a written application to the secretary of the Institution of Naval Architects, 5 Adelphi Terrace, London, W.C.2, to reach him not later than January 15, 1918.

MR. FISHER is still hopeful that the passage of his Education Bill into law will not be postponed indefinitely. Speaking at Swindon on November 10, he said that, though the pressure of Parliamentary business may render it impossible for the Government to proceed with the Bill this session, it must not be supposed that the Bill will therefore be discarded. The Government intends to proceed with the measure at the earliest possible opportunity, always, of course, assuming that the complexion of European events permits Parliamentary attention to be bestowed on domestic legislation. So important is it to the nation that the education of those on whom its industrial efficiency depends shall be extended and improved that we are confident, if the Government is really in earnest, there will be no insuperable difficulty about finding the time at least to pass the educational clauses of the Bill. The meeting at which the President of the Board of Education spoke passed a resolution approving the Bill and protesting against any delay in securing its passage through Parliament.

THE subject of University Representation in Parliament was before Committee of the House of Commons on November 8, in connection with the Representation Bill. Sir Philip Magnus's amendment, giving separate representation with one seat to the University of London and two seats to the group composed of Durham, Manchester, Wales, Liverpool, Leeds, Sheffield, Birmingham, and Bristol, was adopted on a division by a majority of 128 (162 for, 34 against). The amendment was supported by speeches also from Sir William Collins, Mr. Burdett-Coutts, Mr. Macmaster, Mr. Boyton, and Col. Greig, and accepted by the Home Secretary (Sir George Cave). Sir Philip Magnus laid stress on the peculiar constitution, character, and work of the University, and pointed out the practical objections to the large group, including London, proposed by the Bill. This point was emphasised also by Sir William Collins, who said that the three representatives of the proposed group would speak with no sense of individuality, and would represent nothing but a fortuitous and heterogeneous concourse of academic atoms. Sir George Cave said he did not think the Speaker's Conference intended to put a slight upon the University of London, but had in mind the

transferable vote; and if London preferred one representative to itself rather than the half of three to which it was entitled under the Bill and by the number of its graduates, he had no desire to oppose its wishes.

ONE of the great captains of industry of Scotland has specially organised and equipped an engineering factory for the employment exclusively of educated women of good social standing instead of the usual woman factory worker, and with the fixed determination to carry on operations permanently under those conditions, the work to be taken up being that associated with the manufacture of internal-combustion motors. There is a fully illustrated account of the new factory in *Engineering* for November 9, from which we learn that it has some of the salient features of a technical college combined with practical work in the factory, which gives that stimulus to study not realisable in the laboratory of a college. The factory is situated in the south of Scotland amidst beautiful scenery, so that students of botany and of wild-life generally can have full opportunity of pursuing their hobby. All the accessories which are now placed under the wide term "welfare" have been adopted to the fullest extent. Highly trained lecturers conduct classes at the works; these are compulsory. Entrants receive 20s. per week during the probationary period of six weeks; they then decide whether or not they intend to pursue the engineering career. If such be the case, and they are considered suitable, an apprenticeship agreement is entered into, and the wages become 25s. per week. Examinations are held at six months' intervals, and each "pass" means an increase of 5s. per week. It is evident that the whole scheme provides for women the opportunity of prosecuting an engineering career under the most favourable and stimulating conditions, and that the conditions are those best calculated for women of good education and social standing to attain a broad experience of engineering science and practice.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 8.—Sir J. J. Thomson, president, in the chair.—Prof. A. D. **Waller**: The galvanometric measurement of "emotional" physiological changes. The principal object of this communication is to prove that emotional response of the human subject is characterised (and can be measured) by alterations of the electrical resistance of the skin, independent of the well-known muscular and vasomotor and secretory manifestations of emotion.—Lieut. D. M. S. **Watson**: The structure, evolution, and origin of the Amphibia. Part I.—The "orders" Rachitomi and Stereospondyli. In this paper all known genera of Rachitomous and Stereospondylous Stegocephalia are reviewed, the brain-case and basi-cranial region, hitherto practically unknown, being described more or less completely, and much new information about other regions set down.—E. C. **Grey**: The enzymes concerned in the decomposition of glucose and mannitol by *Bacillus coli communis*. Part II.—Experiments of short duration with an emulsion of the organisms. Part III.—Various phases in the decomposition of glucose by an emulsion of the organisms. By selection, Harden and Penfold obtained evidence that the proportion in which the enzymes of bacteria occurred could be artificially modified, which result might suggest that the enzymes, although intracellular, are able to act independently of one another. The present researches demonstrate that this is a fact.

Physical Society, October 26.—Mr. W. R. Cooper, vice-president, in the chair.—T. **Smith**: A class of multiple thin objectives. The objectives dealt with are cemented combinations of several thin lenses. Two kinds of glass only are employed, the odd elements being of one kind, say crown, and the even elements of the other kind, flint. Such lenses may be regarded as combinations of achromatic cemented doublets, and formulæ are found for the aberration coefficients of such lenses in terms of those of a standard doublet when the geometrical conditions for the absence of air-gaps between the components are satisfied. Generally speaking, the results reached are that the outer surfaces are concerned with coma, and the inner surfaces with spherical aberration. In all cases the determination of a system to satisfy given conditions involves only the solution of a quadratic equation, and an algebraic method thus effects a solution in a fraction of the time involved in a trigonometrical investigation. Chromatic differences of first-order aberrations are easily determined. The application of the method is illustrated by a series of quadruple objectives which satisfy the ordinary conditions for telescope objectives. Diagrams show the variation of the curvatures with the different forms, the magnitude of the second order spherical aberration, and the chromatic differences of first-order aberrations.—Prof. J. W. **Nicholson**: The radius of the electron and the nuclear structure of atoms. The electron is usually regarded as a globule of electricity with a definite radius. This conception has proved valuable, but involves difficulties in connection with the nuclear structure of complex atoms. On the view that the electron consists of a region of strain in the æther such line constants should have some significance throughout the whole æther, which may, in fact, be in some manner cellular with these linear magnitudes involved in the specification of the cells, and therefore in any strained structure composed of them. The electron would be regarded as a state of strain which for practical purposes is concentrated at its centre, rapidly diminishing outwards according to some very convergent law involving some line constant in its specification. By way of illustration the idea is worked out mathematically on the assumption that the strain varies as $e^{-\lambda r}$, on which hypothesis λ^{-1} is the "radius." It can be shown that the Lorentz formula for mass as a function of velocity can be obtained for this type of electron. The charge on the electron is regarded as a fundamental property of the æther, and is related to Planck's constant h.

Linnean Society, November 1.—Sir David Prain, president, in the chair.—Prof. W. A. **Herdman**: Spolia Runiana. III., The distribution of certain Copepoda and Diatoms in the Irish Sea throughout the year. The author explained the prevalence of certain genera at definite periods of the year, such as the abundance of seven genera of Diatoms in the maximum attained about April in the many (more than 5000) standard hauls of the plankton-nets on the yacht *Runa*, in some cases reaching hundreds of millions of Diatoms per haul. The Copepoda, which were of much greater size, did not reach such numbers, but attained as many as tens to hundreds of thousands per haul, in the autumn maximum at a period when the Diatoms had practically disappeared. These two periods, spring and autumn, showed monotonic plankton in each case of phytoplankton and zooplankton respectively. The connection between the prevalent plankton and the movement of migratory food-fishes was traced in several cases, and the fact was emphasised that the bulk of the plankton of our seas is made up of a very few organisms present in enormous numbers.—Lt.-Col. J. H. Tull **Walsh**: The germination of *Iris pseudacorus*, Linn., in normal and abnormal conditions.

Aristotelian Society, November 5.—Dr. H. Wildon Carr, president, in the chair.—Dr. H. Wildon **Carr**: Inaugural address: The interaction of mind and body. After a brief allusion to the progress made during

the last two or three decades in the clinical knowledge of mind and body, and particularly to the amount of material for study furnished daily by the injuries of war, the president passed to the consideration whether anything in our new knowledge throws light on the old philosophical problem. He rejected as inconceivable the notion that psychical and physical action can be comprised within one energetical system, or that there can be direct equivalence of exchange between the two orders. The alternative of parallelism, apart from its incredibility on the ground of extravagance, is in direct conflict with the facts of individual experience. The important fact in regard to the nature of mind and body is that each is the unity and continuity of an organic individuality, and that every modification of either is a modification of the whole. Interaction must therefore, it was argued, be interaction between the whole mind as an individual unity of personal experience and the whole body as a living unity of co-ordinated mechanisms. Such interaction is not causal in the sense the term is used in physical science. It is the mutual adaptation of two individual systems distinct in their order, diverse in their function, and divergent in their principle, both of which are necessary and complementary to the common end for which they co-operate, living action. The term which best expresses their interaction is solidarity in its old legal meaning, which denoted the unity of common purpose, the diverse obligations, and the corresponding claims on the members, of a partnership. The philosophical theory sought further to deduce the principle of a dichotomy of living experience into two divergent but complementary systems, mind and body, from the nature of living action.

Mineralogical Society, November 6.—Anniversary meeting.—Dr. J. W. Evans in the chair.—Miss E. **Smith**: Etched crystals of gypsum. Baumhauer conducted experiments on colemanite and calcite to determine whether the phenomenon of etched figures is due to lack of homogeneity or irregularity in the incidence of the dissolving liquid, or to lack of homogeneity in the crystal itself. Further experiments now made on cleavage surfaces of gypsum tend, on the whole, to confirm Baumhauer's conclusion that the second hypothesis is the correct one.—Dr. G. T. **Prior**: The mesosiderite-grahamite group of meteorites. Analyses of the mesosiderite Hainholz and the grahamite Vaca Muerta show that these meteorites do not differ materially as regards the amount of felspar, and microscopical examination of other mesosiderites supports the idea that there is no real distinction between them; the name mesosiderite is therefore proposed for the whole group. The ground-mass of these meteorites consists mainly of anorthite and a pyroxene, poor in lime and having a ratio of MgO to FeO of about 2. The iron and olivine are very unevenly distributed, and have chemical compositions such as they have in the pallasites, the iron being poor in nickel (ratio of Fe to Ni generally greater than 10) and the olivine poor in ferrous oxide (ratio of MgO to FeO from 6 to 9). In accordance with the author's conception of a genetic relationship of meteorites, it is suggested that a eucrite-like magma, *i.e.* one of higher oxidation, was invaded by a pallasite-like magma of lower oxidation. The curiously unequal distribution of the nickel-iron and the shattered (cataclastic) structure, which is generally confined to the parts rich in iron, support this view.—Prof. H. **Hilton**: Changing the plane of a gnomonic or stereographic projection. A method was described by means of which the gnomonic or stereographic projection of a crystal on any plane may be obtained when the projection on one plane is given. The application to the drawing or orthographic projection of the crystal was also discussed.—Prof. H. **Hilton**: Cleavage angle in a random section of a crystal. A graphical method was given by means of which it is possible to calculate the chance that the angle between the cleavage-cracks on a random section of a crystal with two good cleavages may lie between specified limits. The method was worked out in detail for the cases in which the angle between the cleavage-planes was 90° or 60°.

Optical Society, November 8.—Prof. F. J. Cheshire, president, in the chair.—Lt.-Col. A. C. **Williams**: Description of certain optical stores which have been captured from the enemy. The paper dealt with certain optical military instruments which are representative of those employed by the Central Empires. Most of them are used in connection with artillery. The first part of the paper had reference to the general requirements of such instruments and the methods of their employment. The second part contained a detailed description of the instruments, including the optical data, mechanical construction, weight, dimensions, etc. The concluding part contained some observations as to the general design of the instruments as regards serviceability, portability, finish, internal cleanliness, the employment of complicated prisms, and adjustments. Finally, the principal needs as to the designing of military optical instruments in this country were considered, and suggestions given as to the most satisfactory solution of the question.

MANCHESTER.

Literary and Philosophical Society, October 16.—Mr. W. Thomson, president, in the chair.—D. Ward **Cutler**: Natural and artificial parthenogenesis in animals. Parthenogenesis, or the production of an organism from an egg which has not been previously fertilised by the male element, was shown to be of wide occurrence in the animal kingdom, though confined to only a few of its great divisions. The life-cycles of many of the animals which exhibit this method of reproduction were described, and it was pointed out that though fertilisation, among these animals, almost always resulted in the production of females, the sex of the animals developing from parthenogenetic eggs was male in some species, female in others. Experiments were then described which tended to show that the cause of the change from sexual to parthenogenetic reproduction was due to the interaction of the external factors (environment) and internal factors resident in the egg. The cytological aspect of the subject was developed in detail in the paper. Some of the most important theories regarding the cause of sex-production were then discussed, and it was shown that the one put forward by Wilson and Castle seemed at present to fit the facts more nearly than any other. This theory regards male and female formation as a quantitative phenomenon and not a qualitative one; thus "femaleness is maleness *plus* something else." The second part of the paper dealt with the experiments which had been performed on the eggs of various animals that are not normally parthenogenetic, causing them to develop without the action of the male element. This phenomenon has been termed artificial parthenogenesis. Boursier in 1847 stated that a virgin silkworm placed in sunlight and then shade produced eggs from which caterpillars developed, and Tichomoroff was able to get larvæ from unfertilised eggs by placing them for a short time in strong sulphuric acid. Since 1800, however, observations have accumulated enormously, and the substances capable of producing development are many and various. The following are a few of the substances used:—Hypertonic solutions, acids, thermal changes, cytolytic agents, blood sera, shocks from induction coils. Although most observers have worked

with invertebrate eggs, Bataillon has largely confined his attention to the lower vertebrates. He was able by pricking the frog's eggs to cause development, which proceeded in three cases up to the tadpole stage. The various theories which have proceeded from the experiments were then discussed. Finally, it was pointed out that although various substances were capable of inducing development, no factor or factors common to all these substances had been isolated, and that until this was done the problem of fertilisation could not be said to have been solved. Further, it was significant that up to the present no animal had been raised to sexual maturity by artificial means.

October 30.—Mr. W. Thomson, president, in the chair.—Prof. W. Boyd **Dawkins**: The organisation of museums and galleries of art and technology in Manchester. The author gave an outline of the organisation of the Manchester Museum. The scheme of classification is based upon the two great principles of time and evolution. It begins with the ancient history of the earth, dealing first with minerals built of elemental bodies, secondly with the rocks built up of minerals, and thirdly with the history of life as revealed in the rocks. The history of life is represented in its three great stages of evolution—primary, secondary, and tertiary, the series ending with the groups illustrating existing Nature, plants, animals, and man. An account was then given of art in Manchester at the present time, and a scheme outlined for the organisation of a collection of new art in Manchester. The needs of manufacturers and workers generally who look for the best examples of mechanical processes and handicrafts can only be met by the establishment of a great industrial museum.

PARIS.

Academy of Sciences, October 22.—M. Camille Jordan in the chair.—E. **Branly**: Electro-metallic influences exercised through insulating leaves of very small thickness. An experimental study of the conditions under which a very thin sheet of mica exhibits unipolar or bipolar conductivity.—H. **Douvillé**: The Tertiary of the Aquitanian gulf and its differences of facies.—M. **de Sparre**: The influence of the variation of wall thickness on strokes of the ram in a constrained pipe.—G. **Charpy** and S. **Bonnerot**: The heterogeneity of steel. The specimens discussed were etched by a copper reagent, the metallic copper being afterwards removed by solution in ammonia. The advantages of the method are shown by six illustrations reproduced from photomicrographs, four showing the progressive effects of rolling on the structure of the metal.—E. **Goursat**: The integration of certain systems of differential equations.—S. **Bays**: The triple cyclic systems of Steiner.—H. **Larose**: The uniform movement of a wire in a resisting medium.—C. **Camichel**, D. **Eydoux**, and M. **Gariel**: The strokes of an hydraulic ram.—M. **Mesnager**: The thick rectangular plate, loaded at the centre, and the corresponding thin plate.—J. C. **Solá**: The parallax of the star P Ophiuchi. An application of the stereoscopic method; the parallax found for this star is $0{\cdot}418'' \pm 0{\cdot}24''$.—M. **Brillouin**: The electromagnetic field of an element of constant current in a biaxial anisotropic medium.—A. **Mailhe** and F. **de Godon**: The transformation of secondary and tertiary fatty amines into nitriles. Di*iso*amylamine, passed over reduced nickel at 300°–320°, gives amylene, hydrogen, ammonia, tri*iso*amylamine, and *iso*amylnitrile. Tri*iso*amylamine, under similar conditions, also yields *iso*amylnitrile. The formation of a nitrile is unexpected, and further investigations will be made to see if the reaction is a general one.—M. **Guerbet**: Condensation, under the action of potash, of *cyclo*hexanol with secondary butyl alcohol. The synthesis of 4-*cyclo*hexyl-3-butanol.—L. F. **Navarro**: The structure and petrographic composition of the Pic du Teyde (Teneriffe).—J. **Deprat**: The presence of the Lower Cambrian to the west of Yunnanfou.—H. **Coupin**: The acid excretion of roots. The acid excretion is due, not to the root-hairs, but to the superficial cells of the outer layers, especially when the latter have suffered lesions.—Em. **Bourquelot**: The influence of glycerol on the activity of invertine. Unsuccessful attempts to synthesise sugar by the action of invertine on solution of glucose and levulose led the author to make a study of the hydrolysis of sugar by invertine in presence of glycerol. Without glycerol the inversion is practically complete in seven days; increasing proportions of glycerol cause a progressive weakening in the activity of the invertine, so that in 50 per cent. glycerol solutions only 21·6 per cent. of the sugar was hydrolysed.—M. **Cazin** and Mlle. S. **Krongold**: The use of commercial sodium hypochlorite solutions (eau de Javel) in the treatment of infected wounds. Of 510 patients treated by this solution only three died. The question of the supposed irritating properties of this solution is discussed, and the results of comparative experiments made with Dakin's solution and 0·5 per cent. sodium hypochlorite solution are given.—C. **Benoit** and A. **Helbronner**: The treatment of war wounds by the combined action of visible and ultra-violet radiations.

October 29.—M. Ed. Perrier in the chair.—V. **Cremieu**: Experimental researches on gravitation.—P. **Pascal**: The distillation of mixtures of sulphuric and nitric acids. The boiling points of mixtures of water, sulphuric acid, and nitric acid have been studied and the results shown graphically. The diagrams give all the elements necessary for the theory of the concentration of weak nitric acid in retorts, and the denitration in towers of nitrosulphuric acid mixtures.—J. **Bougault**: The preparation of acyl hydroxylamines, starting with the oximes of α-ketonic acids. By the action of iodine and sodium bicarbonate upon the oxime of an α-ketonic acid an acyl hydroxylamine is formed, CO_2 being eliminated, a nitrile being also formed by a secondary reaction. Thus the oxime of phenylpyruvic acid,

$$C_6H_5.CH_2.C(NOH).CO_2H,$$

gives phenylacetylhydroxylamine,

$$C_6H_5.CH_2.CO.NH(OH),$$

and phenylacetonitrile, $C_6H_5.CH_2.CN$. Other examples are given proving the generality of the reaction.—A. B. **Chauveau**: The diurnal variation of potential at a point in the atmosphere with clear sky. It is shown that part, at least, of the diurnal variation is due to dust particles.—F. **Morvillez**: The leaf trace of the Rosaceæ.—W. **Kopaczewski**: Researches on the serum of *Muraena helena*: the toxic power and physical properties of the serum. The toxic action of the serum remains after thirty days' storage in the dark, but sunlight exerts a destructive effect. The toxic effect disappears after exposure to 75° C.—A. **Lécaillon**: The appearance of "bivoltins accidentels" in univoltine races of silkworm, and the rational explanation of this phenomenon.—J. **Amar**: Rational prothesis of the lower member: a practical model of the leg.

MELBOURNE.

Royal Society of Victoria, September 13.—Prof. W. A. Osborne, president, in the chair.—Dr. C. **Fenner**: The physiography of the Glenelg River. The Glenelg originated in a post-Pliocene uplift forming the low western end of the main divide of Victoria. The uplift having a westerly tilt, all the tributaries enter from the east. Part of the asymmetry results from vigorous tributaries crossing the divide and capturing head-

waters of north-flowing streams, while the flooding of western Victoria with basalt diverted south-flowing streams to the west, and augmented the importance of the Wannon, the principal tributary of the Glenelg River.—Kathleen Haddon (communicated by Sir Bald-

the well-known cat's cradle they are supposed to have reached Europe from China, along with the tea-trade. Similar figures are found to be in use all the world over, and it is, in fact, possible that this is one of the earliest sedentary prehistoric games.—Dr. S. Fern: A method of estimating minute traces of calcium in the blood. To a faintly acid solution containing calcium three-quarters its volume of alcohol is added, then three drops or more of a saturated solution of oxalic acid. It is then shaken up, and within a few minutes a white cloud appears, which under the ultramicroscope shows no crystalline shapes, but rounded bodies, 0·1 μ in diameter. This method is so sensitive that a four-thousandth part of a milligram of calcium can be detected in 5 c.c. volume. The main object of the method is for the estimation of calcium in the blood in different diseases.

BOOKS RECEIVED.

The Organism as a Whole from a Physicochemical Viewpoint. By Dr. J. Loeb. Pp. x+379. (New York and London: G. P. Putnam's Sons.) 2.50 dollars net.

An Ethical System based on the Laws of Nature. By M. Deshumbert. Translated by Dr. L. Giles. Pp. ix+231. (Chicago and London: Open Court Publishing Co.) 2s. 6d. net.

The Electron: Its Isolation and Measurement and the Determination of some of its Properties. By Prof. R. A. Millikan. Pp. xii+268. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1.50 dollars net.

Radiography and Radio-Therapeutics. By Dr. R. Knox. Part i., Radiography. Second edition. Pp. xxv+382+xx+78 plates. (London: A. and C. Black, Ltd.) 30s. net.

British Grasses and their Employment in Agriculture. By S. F. Armstrong. Pp. vii+199. (Cambridge: At the University Press.) 6s. net.

Instinct in Man. By Dr. J. Drever. Pp. x+281. (Cambridge: At the University Press.) 9s. net.

Highways and Byways in Wiltshire. By E. Hutton. Pp. xvii+463. (London: Macmillan and Co., Ltd.) 6s. net.

The Psychology of War. By Dr. J. T. MacCurdy. Pp. xi+68. (London: W. Heinemann.) 2s. 6d. net.

Biologia Marina. By R. Issel. Pp. xx+607. (Milano: U. Hoepli.) 10.50 lire.

Piscicoltura Pratica. By Prof. F. Supino. Pp. viii+327. (Milano: U. Hoepli.) 5.50 lire.

DIARY OF SOCIETIES.

THURSDAY, November 15.

Royal Society, at 4.30.—A New Gyroscopic Phenomenon: E. E. Tournay Hinde.—Investigation into the Imbibition Exhibited by some Shellac Derivatives: A. P. Laurie and C. Ranken.—Phenomena connected with Turbulence in the Lower Atmosphere: G. I. Taylor.—The Relation between Barometric Pressure and the Water Level in a Well at Kew Observatory: E. G. Bilham.

Institution of Mining and Metallurgy, at 5.30.—Slime Treatment on Cornish Frames, with Particular Reference to the Effect of Surface: S. J. Truscott.—Comparative Concentration Tests on Wood and Fluted Glass Surfaces at Porco, Bolivia: H. A. Lewis.

... Society, at 5.—Methods of Staining Embryonic Cartilage: E. S. ...—Notes on Calamopitys: Dr. D. H. Scott.

FRIDAY, November 16.

Institution of Mechanical Engineers, at 6.—Some Notes on Air-Lift Pumping: A. W. Purchas.

MONDAY, November 19.

Aristotelian Society, at 8.—Thought and Intuition: Mrs. Karin Stephen.

Royal Geographical Society, at ...—Sandbanks and Deltas: E. C. Barton.

Society of Engineers, ... and ...pitation: Further Experiments: E. B...

TUESDAY, November 20.

Royal Anthropological Institute, at 5.—Witch Sacrifices: Miss M. A. Murray.

Institution of Civil Engineers, at 5.30.—The Hardinge Bridge over the Lower Ganges at Sara: Sir R. R. Gales.

Institution of Petroleum Technologists, at 8.—The Oil Prospects of the British Isles: W. H. Dalton.

Zoological Society, at 5.30.—The New-born Marsupial and its Mode of Birth: Prof. J. P. Hill.—The Development of *Echinocardium cordatum*: Prof. E. W. MacBride.—(1) New South American Rhopalocera; (2) New South American Arctiidæ; (3) New Butterflies from Africa and the East; (4) Gynandromorph of *Papilio lycophron*, Hbn.; (5) Three Aberrations of Lepidoptera: J. J. Joicey and George Talbot.—Deformity of *os penis* in *Phoca caspica*, Nilsson, Sergius Alpheraky.—Notes on a Collection of ... made by Mr. W. Feather in British East Africa, 1911–13: Lt.-Col. ... M. Fawcett.

Royal Statistical Society, at 5.15.

WEDNESDAY, November 21.

Royal Society of Arts, at 4.30.—Inaugural Address: Science and its Functions: A. A. Campbell Swinton.

Royal Meteorological Society, at 5.—The Twelve-hourly Barometer Oscillation: Dr. G. C. Simpson.—Abnormal Temperature, with Special Reference to the Daily Maximum Air Temperature at Greenwich: W. W. Bryant.

G...ogical Society, at 5.30.

... Microscopical Society, at 8.—Some Foraminifera from the North ..., etc. V. *Thurammina papillata*, Brady: A Study in Variation: E. Heron-Allen and A. Earland.

Entomological Society, at 8.

THURSDAY, November 22.

Royal Society, at 4.30.—*Probable Papers*: Bactericidal Properties conferred on the Blood by Intravenous Injections of Diamino-acridine-sulphate: C. H. Browning and R. Sulbransen.—The Pelmatoporinæ, an Essay on the Evolution of a Group of Cretaceous Polyzoa: W. D. Lang.

Institution of Electrical Engineers, at 6.—Gas-firing Boilers: T. M. Hunter.

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CLASS-BOOKS ON ELEMENTARY CHEMISTRY.

(1) *A Class-book of Organic Chemistry.* By Prof. J. B. Cohen. Pp. viii+344. (London: Macmillan and Co., Ltd., 1917.) Price 4s. 6d. net.
(2) *Practical Chemistry for Medical Students.* By Dr. A. C. Cumming. With preface by Prof. J. Walker. Second edition. Pp. 8+165. (Edinburgh: James Thin, 1917.)

(1) DESPITE the systematic basis of organic chemistry, it is always difficult to initiate students in the study of the subject, and especially to get them to grasp the general principles of the science as a precedent to further study. The majority of elementary text-books are burdened with far too much preliminary detail of an abstract character, so far as the beginner is concerned, before he is brought into touch with the materials and methods of the science, with the result that he finds his studies lacking in interest and objective. This defect is very successfully avoided in Prof. Cohen's book. It bears, in every respect, the mark of the experienced teacher, and is most suitably adapted to the requirements of first-year medical students and of senior science students in schools, for whom it is designed.

The volume is divided into three parts, in the first of which the principles of the subject are illustrated by a detailed elementary study of ethyl and methyl alcohols. By means of these examples typical methods of experiment and investigation employed in the examination of organic compounds and in the determination of their structure are described. A more systematic account of the chief aliphatic compounds forms the second portion of the book, which is concluded with a brief description of the more important cyclic compounds. A series of practical exercises is included in each section, and a set of questions appended to each chapter. These exercises are well chosen, and do much to keep the theoretical work within the scope of experimental knowledge. A few fuller explanations of some reactions and structural relations might be usefully added—for instance, in regard to the acidity of aniline hydrochloride, the relation of azo-colours to their mother-substance, azobenzene, the diazonium formula, and the proof of the presence of the two hydroxyl groups in alizarin. Also, in view of the book being designed for the use of medical students, their interest would have been stimulated by a little more specific detail of the therapeutic properties of such substances as salicylic acid, salol, antifebrin, and phenacetin.

(2) Although a course of practical chemistry for medical students need not differ in character from the instruction required for other students in the more elementary stages of the subject, it is advantageous if the material selected is restricted to such methods of experiment and to descriptions of the properties of such substances as will serve as a helpful introduction to subsequent medical study. From this point of view the experiments described in Dr. Cumming's book are very suitably selected and their sequence is well arranged. The first exercises deal with the manipulation of apparatus, solubility, crystallisation and its value in the purification of compounds. These are followed by an account of the properties of the commoner acids and alkalis, of the preparation and properties of the more important gases, and of the properties of sulphur, iodine, and carbon. These descriptions are accompanied by a series of instructions for qualitative experiments, to which a few simple quantitative exercises—for instance, in the case of carbon dioxide and of hydrogen—might have been added with advantage.

The succeeding sections deal with the preparation of salts, elementary volumetric analysis, and the qualitative reactions of inorganic and of the commoner organic compounds, including the more important alkaloids. In this new edition the subject-matter of the previous issue has been carefully revised and a few additional experiments with bread, potatoes, and fats, the fermentation of glucose, and the action of saliva on starch have been introduced. The descriptions of the experiments and of the associated details of manipulation are throughout direct and concise, so that the course should form a really practical help to the study of the general principles of chemistry.

C. A. K.

AMERICAN GUNNERY.

Stresses in Wire-wrapped Guns and in Gun-carriages. By Lt.-Col. Colden L'H. Ruggles. Pp. xi+259. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 13s. 6d. net.

THE preface to this the second edition explains that the text was originally prepared for the cadets of the U.S. Military Academy. The title does not fully indicate the contents. The elastic stresses in wire-wrapped guns are the subject only of chap. i., pp. 1–36. Chaps ii. and iii., pp. 37–105, deal with the forces which the firing of the gun occasions in the principal parts of the carriage, the 3-in. field carriage, the 5-in. barbette carriage, and the 6-in. disappearing carriage being taken as examples. The problems are dealt with in these two chapters as problems in ordinary statics and dynamics. Chap. iv., pp. 106–73, treats of the elastic stresses in parts of gun-carriages. Chap. v., pp. 174–227, if not very obviously connected with the professed subject of the book, gives a clear descriptive account of "toothed gearing." The subject of the last chapter, vi., counter recoil springs, has more connection with guns than might appear at first sight.

The numerous illustrations, which form a great feature of the book, are generally very clear. Some, especially those relating to toothed gearing—for instance, Figs. 78, 80, 89, and 93—are quite works of art. If scarcely necessary for the

information of those who have actually to handle the objects illustrated, they at least adorn the book. Another great feature is the number of numerical illustrations of the formulæ. Even if the student does not properly understand the formulæ, or the physical principles on which they depend, the guidance afforded by the numerical illustrations will probably enable him to deal with concrete cases. The book, in short, seems intended for the man for whom facts are a necessity, but reasons a luxury. If the form and contents of the book were dictated, as one would naturally suppose, by the wants of U.S. military cadets, the most natural inference is that when the cadet commences the study of ordnance he does not possess that knowledge either of mathematical analysis or of the mathematical theory of elasticity desirable for a critical study of the problems presented by wire-wrapped guns and recoil springs.

The author begins his treatment of wire-wrapped guns by quoting from Lissak's "Ordnance and Gunnery" formulæ for the strains and stresses in a hollow circular cylinder. The first formula, as ill-luck will have it, suffers from a printer's error, R_0 for R_0^2. The differences between stresses and strains and the relations between them are not made altogether clear, the expressions for the strains being multiplied by E, Young's modulus, and there being no explicit reference to Poisson's ratio, which is tacitly assumed to be $1/3$. This, no doubt, simplifies the mathematics, and a further simplification is effected by accepting a common value of E for the forged steel of the tube, the steel wire of the winding, and the cast steel of the jacket. These materials are supposed to differ only in their "elastic limits." These assumptions may be necessary to bring the problem within the powers of the average cadet, but there are, it is to be hoped, superior cadets who would benefit by having the limitations of the formulæ pointed out. It is to be feared that the reader will find the way of reaching the formulæ relating to the elastic strains and stresses produced by wire-wrapping rather a feat of jugglery. He is also not unlikely to miss the fact that the inferences as to elastic limits are generally based on a greatest strain theory.

The student who will derive benefit from the treatment of elementary elastic problems given on pp. 106–20 has not reached the stage of knowledge desirable when tackling wire-wrapped guns. There is, moreover, no clear statement of principles. Formulæ are quoted from various sources, apparently simply that they may be available for reference in connection with the numerical illustrations. No warning seems to be given as to the risks in applying to short and irregularly shaped beams formulæ based on the Euler-Bernoulli treatment of bending.

The treatment of helical springs in the last chapter, though very arbitrary, seems fairly satisfactory so far as concerns springs in which the section of the original bar is circular: but the extension to cases in which the section is rectangular invites criticism. The formulæ obtained for the circular section involve a quantity I_p, what is called the "polar moment of inertia" (otherwise $\pi d^4/32$, where d is the diameter). The same formulæ are applied to springs coiled from bars of rectangular section, $h \times b$, with the following explanation: "As first shown by Saint-Venant . . . a plane section whose axes are unequal becomes a warped surface when subjected to great torsional strain. . . . Reuleaux states that the polar moment of inertia of a rectangle when subjected to great torsional strain is

$$I_p = (hb)^3 \div \{3(h^2 + b^2)\},$$

and that the distance from the centre of gravity to the point of the section most distant from it is $r = hb(h^2 + b^2)^{-\frac{1}{2}}$." The author then inserts these expressions for I_p and r in the formulæ deduced for the circular section. The student will naturally infer that the "warping" appears only when the torsional couple is large, and his ideas as to the geometry of a rectangle must receive something of a shock. The author does not seem well advised in using the same letter E to denote the rigidity and Young's modulus.

A work which contains so much information about U.S. ordnance, even if not the absolutely latest patterns, and the methods employed by U.S. ordnance experts will naturally appeal to an unusually wide circle at present.

ISAAC BARROW.

The Geometrical Lectures of Isaac Barrow. Translated, with Notes and Proofs, by J. M. Child. Pp. xiv + 218. (Chicago and London: Open Court Publishing Co., 1916.) Price 4*s.* 6*d.* net.

MR. CHILD begins by laying down the startling thesis that "Isaac Barrow was the first inventor of the Infinitesimal Calculus; Newton got the main idea of it from Barrow by personal communication; and Leibniz also was in some measure indebted to Barrow's work." To interpret this according to the writer's intention we must use the term "calculus" to mean a set of analytical rules applied to analytical expressions; with this restriction, Mr. Child has made out a case that is convincing enough in this sense, that if Barrow had been given any function likely to be constructed in his time, he would have been able to differentiate it by applying a few standard rules.

It is extremely interesting to read Barrow's lectures, because they were written at a time when the power of the new analysis was becoming apparent, whereas every mathematician of note had been thoroughly grounded in the classical geometry of the Greeks. Barrow makes considerable use of algebraic symbols—otherwise we could only say that he generalised the methods of Fermat and others; even the fact that he practically gives rules for differentiating a sum, product, quotient, etc., would not make him the inventor of the calculus. At the same time Barrow's treatment is, in the main, geometrical, and we feel that he would like to make it completely so, if he could.

The outstanding features of the lectures may be summarised as follows:—Barrow regards a curve as the locus of a moving point, and makes its velocity at any moment the resultant of two velocities parallel to two fixed axes; one of these velocities is taken to be constant, and then the nature of the curve determines the other component velocity for any position of the moving point. Barrow does *not*, like Newton, consider the calculation of the variable velocity ($\dot{y}$); he constructs an infinitesimal triangle, and from this determines, generally by a sort of method of "exhaustion," the value of the subtangent, or some such finite segment, from which the position of the tangent can be inferred. Barrow's rule for differentiating a product accordingly appears in a form equivalent to

$$d(uv)/uvdx = du/udx + dv/vdx,$$

and similarly for a quotient. It may be added that Barrow gives (Lect. x., ex. 5) an analytical proof of a proposition equivalent to

$$d \tan x/dx = \sec^2 x,$$

and in this he neglects small quantities of higher order than the first. It is, therefore, practically certain that, if he had chosen to do so, Barrow could have written an algebraic treatise on the differential calculus; and to this extent Mr. Child's contention seems to us to be fully justified. Barrow was probably too enamoured of the old geometry to wish to do anything of the kind; and we may venture to think that he had no conception of the immense importance of an abstract, arithmetical calculus for mathematics in general. It is here that the value of Leibniz's contributions becomes so manifest, and it matters little how far he was really indebted to Barrow's lectures, of which he was known to have had a copy.

Mr. Child gives paraphrases (in modern notation) of the most important parts of the lectures, with notes of his own in different type. At the end we have a reduced facsimile of two pages of the original, and of a sheet of the original diagrams. So far as we have tested it, the paraphrase is satisfactory; p. 57, ll. 14, 16, "decreasing" and "decrease" should be "increasing" and "increase," and p. 66, last line, "that I know" should be "so far as I know," and there may be other similar slips. Altogether, Mr. Child may be heartily congratulated on the result of his six months' research. G. B. M.

OUR BOOKSHELF.

The Distances, Absolute Magnitudes, and Spectra of 734 Stars. Arranged for Use with Ordinary Star Maps by T. E. Heath. Pp. iv+52. (Tenby: Sold by Miss Crealock, South Cliff Street, Tenby, n.d.) Price 2*s.* 6*d.* net.

THE determination of the distance of a star, by measuring its minute change of position when seen from opposite points of the earth's orbit, is an extremely laborious work. According to Mr. Heath's pamphlet, the parallaxes of about 700 stars constitute the total output up to now from the various observatories of the world; and for many of these the only information obtained is that the star is at a great but unknown distance beyond the reach of the method. The general fate of these data is to fall into the hands of some mathematical astronomer, apparently actuated by an irresistible impulse to add things up and take the mean; then comes a sudden jump to mathematical formulæ; integrals gather in formidable array, and the error-function makes its inevitable appearance; and so the riddle of the universe is slowly disentangled—or knots itself tighter—to the great satisfaction of those who have any notion what it is all about.

Mr. Heath is one of those who would rescue the precious knowledge from this socialistic use. For him the stars each have their individuality; they are personal acquaintances, not mere items on a census-form. When he looks at the Great Dog, in his mind's eye he sees Sirius a modest star of 30 sun-power eight miles away (to use his "Road-Book" scale), and its less conspicuous neighbour Beta, a brilliant globe of 750 sun-power 223 miles distant. Then turning to the gleaming belt of the Milky Way, on the same scale, "if we took ship to America we might probably come to the beginning of the Milky Way before we arrived, and get through it before we came to the Pacific." And so he places out the stars at their different distances and gives the true measure of their brightness.

There must be many watchers of the skies to whom the stars will acquire a new interest from the information here set out. It has hitherto been practically inaccessible except to specialists. Mr. Heath does not conceal the fact that the individual results are often very uncertain; they are taken from the best authorities, but it is only for exceptionally near stars that the distances are known at all closely. But we can agree with him that on the whole a true general view is conveyed. We are glad to learn that the author has presented a large number of copies to the Admiralty for distribution among the Fleet. A. S. E.

The Road and the Inn. By James John Hissey. Pp. xviii+435. (London: Macmillan and Co., Ltd., 1917.) Price 10*s.* net.

THE latest addition to Mr. Hissey's already long list of travel books will delight every lover of English byways. In a small motor-car, provided with camera and brush, Mr. Hissey went from lane to lane from Eastbourne to the Dukeries, Rugby being his most westerly, and Dunwich his most easterly, visit. There was no hurry and no bustle; and he preferred the country inn to the town hotel, for his "aim was to get into the heart of the real country." The serenity and charm of his gossipy narrative show how well he succeeded in securing the quiet holiday he desired; and the beauty of his photographs and drawings indicates his re-discovery of some of the hidden glories of the English countryside.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

On the Theory of Magneto-ionisation.

I BEG permission to make a few remarks on the note in NATURE of September 13, p. 32, in which one of my latest papers is criticised, the one in which I gave, I think, a direct proof of magneto-ionisation.

In the experiment which the writer of the note takes into consideration the intensity of the current in the air ionised by a beam of X-rays between two parallel metal plates is measured. I find that a magnetic field directed perpendicularly to the electric field, and the intensity of which is below a certain value, causes an increase of current, although the deviations of the ions and electrons tend to produce a decrease. This effect is uncertain in the case of small potential differences, but it becomes considerable when ionisation by collision begins.

The writer of the note remarked that "when a magnetic field of 430 gauss is superimposed, there is found a current decrease . . ." Now, the numerical table to which he alludes is not the only one given in the paper, and it shows such a decrease (which is very small) in one case only, which may be considered as accounted for by experimental error, since nothing of the kind is found in the other numerical tables. That, of course, leads one to suppose that the writer is not fully acquainted with certain parts of my work, and what he says farther on seems to confirm this supposition: "In the opinion of the writer of this note Prof. Righi's interpretation of his results is by no means the only one which is possible, and though his ingenious experiments are of great interest, his theory will need further support before it obtains general acceptance. In particular, it will be necessary to show that the increase of current is not caused by the oblique, and therefore longer, paths of the ions under the joint actions of the two fields."

The writer then offers a new theory, or, more exactly, he states a general idea, which he seems to consider to be preferable to my theory. But this idea cannot be admitted, as I now propose to show.

Apart from the fact that the writer appears to believe that the effect of the magnetic field is simply the obliquity of the trajectory of the ions, whereas these trajectories become certain well-known curves (which may be deduced from the formulæ given in the third paragraph of the note added to my paper), I at once make the fundamental objection that it is not sufficient to increase the distance travelled over by an ion in order that the latter may become capable of ionising a larger number of atoms. In fact, as in ionisation by collision an ion loses a part of its kinetic energy, it would be necessary to prove that the magnetic field causes the said energy to increase. Now this is not at all the case, since by means of the formulæ of the movement of an ion in an electric and magnetic field it is demonstrated that when the ion traverses a plane perpendicular to the electric field it possesses exactly the same velocity, be the magnetic field existent or not.

It may be added that when the magnetic field does exist, the speed of the ion may increase only to a maximum value, after which it decreases again, the ion retroceding in respect of the lines of electric force, while if the magnetic field does not exist, the velocity may increase without limit, provided it be not stopped by the electrode which attracts it or by collision with molecules. All this is clearly understood when one knows that, apart from the velocity parallel to the magnetic force, which remains constant, the trajectory of the ion is nothing but the curve described by a point travelling at a constant speed over a circumference, while the latter is itself travelling uniformly in a straight line in a direction perpendicular to the two fields.

Finally, I wish to point out that, even if the idea expressed by the writer of the note did not lack a basis, my theory could not easily be rejected. It is, in fact, but a direct consequence of the conceptions already accepted by most physicists, nor does it need the addition of any subsidiary hypothesis.

As a matter of fact, it being admitted that atoms have satellite electrons, they must tend to orient themselves in the magnetic field as if the orbits of such electrons were closed electric currents. Now the sense of this orientation is such that the force due to the field, and acting on the electrons, is directed towards the outside of the orbits, which causes a decrease of the energy required to detach them from the rest of the atoms.

It is this facility of ionisation produced by the magnetic field that constitutes "magneto-ionisation."

AUGUSTO RIGHI.

Bologna (Italy), September 27.

I AM sorry if, owing perhaps to the brevity of my note, I have led Prof. Righi to think that, in my opinion, his theory of magneto-ionisation can be "easily rejected." Nothing was further from my intention. I believe I have read all Prof. Righi's papers on the subject as they have appeared, and have repeated some of his experiments. The impression they have left on my mind is that, although Prof. Righi's theory gives a plausible explanation of the complex phenomena investigated, yet it is not the only one possible, and further work is necessary before a final conclusion can be reached. I did not express a *preference* for another theory. I merely suggested objections that would have to be met before the theory under discussion could be unhesitatingly accepted. The question as to whether I have given a fair account of the numerical results must be left to the decision of the readers of the memoir.

THE WRITER OF THE NOTE.

The Introduction of the Word "Magneton."

THE word "magneton" is now so frequently used that it has seemed worth while to me to seek to learn to whom is due this addition to the vocabulary of physics.

So far as I can find, Dr. L. A. Bauer was the first to employ the word. In the weekly journal, *Science* (June 10, 1910, vol. xxxi., p. 920), is a report of a meeting of the Philosophical Society of Washington, D.C., held on May 7, 1910. There is included an abstract of a paper by Dr. Bauer entitled "Is there an Emanation from a Magnetised Substance?" in which the following occurs:—"The corpuscles in magnetism might be atomic systems in which the electron is revolving about an inner nucleus consisting, for example, of a positive ion, such as assumed by Righi for the formation of his so-called 'magnetic rays.' . . . Since the system creates an atomic magnetic field the axis of which passes through the centre of rotation of the electron and perpendicular to the plane of rotation, the speaker suggested calling such systems 'magnetons.'"

In a letter to me Dr. Bauer says:—"The term was used not only in my paper before the Philosophical Society of Washington on May 7, 1910, but also in my

lectures on terrestrial magnetism at the Johns Hopkins University a month or so previously."

Because Prof. R. Gans had used the same word quite early, I wrote to him to ask his aid in locating its earliest occurrence. He replied to me from Argentina, saying:—"Auch mich interessirt es zu wissen wer das Wort 'Magneton' zum ersten Male gebraucht hat. Ich selbst habe wohl das Wort zuerst in der von Ihnen erwaehnten Arbeit in den *Göttinger Nachrichten*, 1910, verwendet. Die Arbeit von Bauer, den Sie zitieren, kenne ich nicht." The article referred to by Prof. Gans in *Göttinger Nachrichten*, 1910, p. 200, was presented at the session of May 28, 1910, by C. Runge. In the course of the discussion we find this: "Die lage jedes Molekularmagneten, oder wie wir kuerzer sagen wollen, jeden Magnetons. . . ."

Since Prof. Pierre Weiss conferred on the word under investigation the quantitative meaning which it seems likely to retain, I turned to him also for assistance. He wrote me in reply:—"J'ai imaginé le nom de 'magnéton' à la suite de mes recherches expérimentales. L'analogie avec l'électron s'imposait. J'ai eu connaissance plus tard que M. Gans avait fait usage antérieurement du même terme dans un sens différent. Il me semble que, dans ce sens, l'expression de molécule magnétique convient tout aussi bien. Je n'avais pas connaissance jusqu'à présent de l'emploi fait de ce terme par M. L. A. Bauer et je vous remercie du renseignement."

In the *Comptes rendus* of the Paris Academy of Sciences, vol. clii., p. 189, session of January 23, 1911, occurs the first use of the word by the Zurich physicist in an article called "Sur la rationalité des rapports des moments magnétiques des atomes et un nouveau constituant universel de la matière." Near the close we come upon the following:—"Le nombre d'atomes dans l'atome-gramme est $N=70\times10^{22}$ (Perrin). Le quotient m; $N=15{\cdot}94\times10^{-22}$ est le moment de l'aimant élémentaire lui-même, correspondant à la partie aliquote des moments des atomes-grammes. Je l'appelerai magnéton. . . . Le magnéton est donc un constituant universel de la matière."

It is surely interesting to note that three physicists in as many different countries independently introduced the word within a year. Priority appears to belong to Dr. Bauer.

As some uncertainty can be observed in the pronunciation of "magneton," I appealed to its sponsor, Dr. Bauer, for a decision. He replied: "I hesitate greatly desiring to appear competent to pass on the official pronunciation of the word 'magneton.' I prefer the accent on the second syllable, and giving the sound of *e* as in 'thee,' thus—magneeton. Still, I should not quarrel with anyone who wishes to put the accent on the first syllable and pronounce the *e* as in 'met.' Usage alone will decide." GEORGE F. STRADLING.

Northeast High School, Philadelphia.

An Optical Phenomenon.

A DESCRIPTION of the phenomenon mentioned by Capt. Cave in NATURE of October 18 will also be found in NATURE, vol. lxx., p. 107 (1904), and vol. lxxviii., pp. 255, 277, and 305 (1908). J. W. GILTAY.

Delft, November 9.

THE NICKEL INDUSTRY.

THE complete report of the Royal Ontario Nickel Commission, of which a summary was published in March last, has recently been received in this country. It is a document of absorbing interest and exceptional importance. The commission was appointed on September 9, 1915, and asked to inquire into, and investigate and report upon, the resources, industries, and capacities, both present and future, of the Province of Ontario in connection with nickel and its ores. Its reference also included an inquiry into the system of taxation by the province of its mines, minerals, and mineral industries. There were four commissioners, Messrs. Holloway, Miller, Young, and Gibson, representing metallurgy, geology, law, and administration respectively. They set to work at once and completed their labours in eighteen months—a remarkably short time considering what they did. Their report contains nearly 600 pages, and the appendix more than 200. It is a model of lucidity of exposition, and displays such a complete grasp of the subject in all its bearings and details, and such shrewdness of judgment in regard to its recommendations, that it will certainly rank as the most authoritative monograph on the nickel industry that has ever been published. The commissioners have rendered to Canada a service of remarkable value.

It appears that, so recently as 1900, as much as 65 per cent. of the world's market was supplied by nickel made from the New Caledonia ores, the balance being furnished by Canadian ores. New Caledonia, although discovered and named by Capt. Cook in 1774, was not claimed by any European country until 1854. In that year it is said that a French and a British frigate sailed simultaneously from Sydney (Australia) to take possession of it. The former was the first to find a way through the barrier reef and thus secured the island for France. The commissioners comment on the striking fact that "two countries so widely separated as are Ontario and New Caledonia, not only by distance, but in almost every other way, should alone be rivals, not merely in the production of nickel, but in that of cobalt as well."

For many years nickel from New Caledonia had an established world market. It was included in all British Government specifications where nickel was required. When the Mond Nickel Co., working on Sudbury ores, entered the field, it found an immensely strong prejudice both in Government departments and the trade against them, which was overcome only after elaborate and expensive trials and tests. Moreover, the New Caledonia nickel had for many years a tied market among the principal consumers in Europe, owing to the close business connections of the leading French producer—Le Nickel—with the great armament firms. This company has the financial backing of the Rothschilds and is the chief rival of the Canadian companies.

Since 1900 Ontario has forged ahead with its production. The world's output has increased sixfold since that time, and of this Ontario now furnishes about 80 per cent. The main factor in this change is the great difference in the size of the ore-bodies in the two countries. Whereas those of New Caledonia are reckoned in at most hundreds of thousands of tons, the Sudbury (Ontario) deposits are measured in millions. In spite of its apparently favourable position, how-

ever, the main questions which the commissioners had to answer were not easy. They were: (1) Are the nickel deposits of Ontario of such a character that this province can compete successfully as a nickel producer with any other country? (2) Can nickel be economically refined in Ontario? When they took up their work they were faced with the opinion of the companies interested that the answer to the latter question was in the negative. They also found that "for nearly fifteen years the whole of the great and highly profitable industry connected with the production of refined nickel from the vast deposits of nickel-copper ores in the Sudbury district has been divided between two powerful corporations. Both companies mine, smelt, and refine their own ore, and possess their own process of refining; both produce their refined metal product outside of Canada, and neither is a Canadian company. Other companies, British, American, and Canadian, some of them with excellent promise of success, have operated mines, erected plants, or have been otherwise engaged in the industry. *In no case has any of their undertakings been permanent or successful.*" They had also to reckon with the fact that there is no certainty that large profits can be made every year from the nickel industry. It is neither a necessity of life nor an article of universal consumption or use. Its uses may be classified under four headings: (1) as a component of alloys; (2) as a surface coating for other metals; (3) as a chemical or catalytic reagent; (4) as a pure metal. In the past the output has had to be curtailed at times.

In spite of these facts, the commissioners have had "no hesitation" in answering both the above questions in the affirmative. They say that the nickel deposits of Ontario are much more extensive and offer better facilities for the production of nickel at low cost than do those of any other country. Nickel-bearing ores occur in many parts of the world, but the great extent of the deposits in this province, their richness and uniformity of metal contents, and the success of the industry point strongly to the conclusion that Ontario nickel has little to fear from competition. They say also that any of the processes now in use for refining nickel could be successfully worked in Ontario, and conditions and facilities are at least as good in this province as in any other part of Canada. There is now an "assured prospect" of the erection in Ontario of two large plants for the refining of nickel—one by the International Nickel Co. of Canada at Port Colborne (Lake Erie), and the other by the British America Nickel Corporation, probably at Sudbury. The latter company, in which the British Government is a large shareholder, has been formed since the outbreak of the war. For special reasons the Mond Nickel Co. will continue to refine at Clydach, near Swansea. In its business the manufacture of copper sulphate is almost as important as that of nickel, and this is marketed chiefly at Mediterranean ports.

H. C. H. CARPENTER.

STUDIES IN INFANT AND CHILD MORTALITY.

IN view of the importance which must be ascribed at the present time to the saving of child life (see NATURE, October 26, p. 146), the Medical Research Committee has been well advised to institute an inquiry into the causes of death in infancy and childhood. The results of this inquiry have now been published in a series of essays,[1] which, it is pointed out in an introduction, have been written primarily with a view to the planning of future lines of research rather than for publication as finished reports.

An introductory historical note is contributed by Dr. Chalmers, in which he remarks that deliberate effort to conserve infant life can be said only to have begun with the recognition of the contrast which the movement in the death-rate of infants presents when compared with that of the general death-rate. Whereas the latter fell continuously and considerably during the fourth quarter of the last century, fluctuations of the infant-mortality rate remained fairly constant and without very marked indication of a corresponding decrease.

The first report, by Dr. Brend, deals with the relative importance of pre-natal and post-natal conditions as causes of infant mortality.[2] He concludes that under the term "infant mortality" we are classing together two radically different types of deaths, which are brought about by different causes and are governed by different influences. The first type consists of deaths due to developmental factors which vary but little in place, time, and class of the population, and appear to be caused by fundamental influences which we neither understand nor are able to control. The second type consists of deaths mainly due to respiratory diseases and enteritis caused by the influence of the post-natal environment—over-crowding, atmospheric pollution, etc.—and probably entirely preventable. These two types of death overlap somewhat in time, but the end of the first month after birth provides a fairly sharp line of division. Some three-quarters of the mortality during the first month represents a bedrock loss of life which we have hitherto failed to reduce and which is mainly due to developmental conditions, while mortality after the first month is part and parcel of the general mortality of childhood, due to the same causes and demanding for its reduction the same measures.

Dr. Brend suggests that it might be of advantage to divide "infant mortality" into "birth mortality," the deaths during the first month, and "mortality of early childhood," the deaths from the end of the first month to the end of the third year.

In the second report Dr. Findlay discusses the causes of infantile mortality. He brings out the importance of environment (housing, etc.) as a factor in causing the present high infantile mortality, and he urges the need for a more scientific

[1] "The Mortalities of Birth, Infancy, and Childhood." Medical Research Committee, Special Report Series, No. 10, October, 1917.

[2] In vital statistics the term "infant mortality" is used to denote the deaths of infants up to one year of age.

investigation of the results following schemes of infant welfare if their true effects are to be determined. With regard to the latter, the danger of "overdoing it" is emphasised. For instance, in Poplar, in spite of an extensive infant welfare scheme in being, the infantile death-rate has risen. It is suggested that this disappointing result may be traceable to the people being harassed by a multitude of health visitors, which upsets them and makes them disinclined to adopt the measures urged upon them.

The third and final report is a statistical study by Dr. Brownlee of some of the data relating to infantile mortality. It is shown that the growth of the child is a continuous process from a period at least six months prior to birth up to the age of about four years, a process which is not interrupted either by the act of birth or by the act of weaning.

Certain disease conditions have also been investigated. Convulsions diminish in a perfectly definite manner from the age of two months to that of four years. In the group of premature births and wasting diseases some considerable saving of infantile life seems to be possible. The group of diarrhœal diseases is found to be a homogeneous statistical group, though it undoubtedly includes several distinct specific infections, from which it is inferred that the reason for the frequency of these diseases at the ages at which they occur must be sought for in the development of the child rather than in the type of parasite. Scarlet fever, measles, bronchitis, and pneumonia have also been investigated.

From the foregoing brief summary it will be seen that this report contains matter of much importance, and its appearance at this time is most opportune. R. T. H.

BARON DAIROKU KIKUCHI.

BARON KIKUCHI, whose death took place on August 19, was one of the most conspicuous among the band of men who modernised education in Japan. He was born in Yedo (now Tokyo) on March 17, 1855, and came of a family of noted scholars. Both his father and grandfather were specially interested in Western learning, and Kikuchi himself early received a strong bias in the direction of scientific study. He was the youngest member of a small group of promising students whom the old Shogunate Government sent to Europe in 1866. Owing to the revolutionary change of government which occurred in Japan in 1868, Kikuchi was recalled home; but two years later he was again ordered abroad, this time to England. After some years spent at school he entered the London University College in 1873, but ere long passed on to Cambridge, where he graduated as nineteenth wrangler in 1877.

Returning home, he became professor of mathematics in the college where he had been himself a young pupil, which had developed gradually to the standard of a university. Originally known as the Kaisei-gakko, this school grew into what was afterwards known as the Tokyo University, and this in due course amalgamated with the Kobudaigakko, or College of Engineering, and became the highly organised Imperial University of Japan.

It was in the Tokyo University that Principal Sir J. A. Ewing, then professor of engineering and physics, carried out his well-known experiments on magnetic hysteresis; and associated with Kikuchi in these and later days were Edward Divers, professor of chemistry, C. D. West, professor of mechanical engineering, John Milne, the famous seismologist, as well as others, including the writer of this notice. Our intercourse with Kikuchi was marked with cordiality and mutual appreciation from the first, in great measure due, no doubt, to his experience as a schoolboy and student in London and Cambridge. He greatly admired the English genius for self-imposed discipline, and used to say that if he had not been a Japanese he would have desired above everything to be an Englishman.

From 1881 Kikuchi added to his professorial duties the office of the Dean of the College of Science, a highly responsible post at that time of strenuous educational development. As one of the members of the House of Peers under the new Constitution he was of great service in advancing various Bills of educational and economic importance, and rapidly established for himself a high reputation as a man of sagacity and administrative power. The mere enumeration of the public offices which he filled is a tribute to the confidence his fellow-countrymen reposed in him. In succession he held the posts of Vice-Minister of Education (1897–98), President of the Imperial University, Tokyo (1898–1901), and Minister of Education (1901–3).

As one of the representatives of the Imperial Academy of Japan, he attended the meeting of the International Association of Academies at Vienna in 1907, and thereafter spent a considerable time in this country. His course of lectures on Japanese education, delivered in that year under the auspices of the University of London, were published in English in 1909. This book contains the first systematic account of the history of education in Japan given to the world at large, and will ever remain a work of great value to the educational historian. A remarkably succinct sketch of the fundamental characteristics of the old Japanese civilisation, and of the way in which it proved itself equal to the absorption of Western learning, was given in an address delivered before the Royal Society of Edinburgh in June, 1907, and published in the Proceedings (vol. xxvii.).

After this stay in Europe, where Kikuchi renewed acquaintance with many former friends and made many new ones, he returned to Japan to take up again responsible educational duties. Up to the day of his last illness he was in the midst of all movements which were making for efficiency in education. In March of this year, for example, he was appointed director of the newly established National Physico-Chemical Institute.

Called comparatively early in life to take a great

and ever-increasing share in shaping the destinies of his country in regard to science and higher education, Kikuchi had scant leisure for mathematical research. His chief work as an investigator was historical, and he contributed a number of papers to the Tokyo Mathematical Society on the mathematics of the old Japanese school. He also wrote a text-book on elementary geometry for use in Japanese schools and colleges. Of far greater moment to his country, however, was his disinterested devotion to the cause of the higher learning in science and morals. It was for this that he was created a Baron in 1902. His successive honours came to him simply because he was indispensable to his country and to his sovereign. But to the end he retained all the characteristics which endeared him to us—modest, courteous, gracious, always acting from the highest motives, strong in purpose yet never aggressive, and combining in a singular degree the finest traits of the Japanese Samurai with the best qualities of the youth of England. At the most impressionable time of life Kikuchi lived under the full influence of the best culture our island kingdom can offer; and we may be pardoned for regarding his pre-eminent success as in no small measure due to his unconscious training in a land where liberty, individuality, and zeal for the common good are of the very air we breathe. C. G. KNOTT.

NOTES.

IN three Chadwick public lectures on the part of hygiene in the European war Dr. Woods Hutchinson gave some noteworthy facts in connection with the progress of military hygiene. The present world-struggle is probably one of the least deadly ever fought in proportion to the numbers engaged. Less than 5 per cent. of the wastage of former wars was due to wounds or deaths in battle; the other 95 per cent. was caused by disease. In the armies themselves the ratio was six to nine deaths by disease to one in battle or from wounds. In this war the ratio is sixteen deaths in battle to one from disease. Of the wounded who survive six hours 90 per cent. recover, of those who reach the field hospitals 95 per cent. recover, and of those who arrive at the base hospitals 98 per cent. get well. Barely 5 per cent. of the wounded are crippled or permanently disabled. There is good reason to believe that the death-rate of this war does not exceed 5 per cent. per annum. The subjects of food and diseases of an army were also discussed. The superb health and vigour of our armies on the Western front are due largely to the rich and abundant supply of food. These armies had less sickness and fewer deaths from pneumonia and other diseases than they used to have in barracks in times of peace. The old plagues of army camps—cholera, Black Death, and spotted typhus—all lifted their heads in Italy, in Serbia, and in Russia, but all were promptly stamped out by modern sanitary science. The total number of cases of serious or lasting "shell-shock," so called, and mental disturbance, during 1916 in the trenches in France, was 2600, fewer than one per 1000 of the armies in the field, and fewer than half of the ordinary insanity rate in men of military ages in times of peace. Modern nerves had stood the fearful strain of this war superbly.

AN appeal to the Local Government Board to take action towards establishing a Ministry of Health was made by a deputation from the Standing Joint Committee of Industrial Women's Organisations which waited on the President of the Board (Mr. Hayes Fisher) on November 16. Mr. Stephen Walsh (Parliamentary Secretary) was also present. The organisations represented were the Women's Trade Union League, the Women's Co-operative Guild, the Women's Labour League, the National Federation of Women Workers, and the Railway Women's Guild. It was urged that the new department's basis must be the public health side of the Local Government Board, and that it would not serve merely to re-name that Board the Ministry of Health. Such a Ministry should take into partnership the National Insurance Commissioners, and it was absolutely essential that it should be dissociated from the old Poor Law system. On the same day Mr. Hayes Fisher received a deputation on the same subject from the Society of Medical Officers of Health, and the Association of County Medical Officers of Health. Mr. Hayes Fisher, in replying, said that the Local Government Board was asking for a Bill that would enable local authorities in England and Wales to do all the things that were being asked of the new Ministry of Health. This Bill had not been able to go any further because the National Insurance Commissioners were asking for similar powers in respect of infant welfare and maternity. Whoever might obtain the powers, the responsibility for carrying them out would rest with the medical officers of health.

THE stress of war has brought success sooner than was anticipated to the efforts which have been made for many years to secure the establishment of a National Seed-testing Station for England and Wales. Scotland and Ireland have for several years had the advantage of such stations, and now England has at last fallen into line. The new station, which is associated with the Food Production Department of the Board of Agriculture, was formally opened on November 14 by the President of the Board, whilst the same evening the text of the Testing of Seeds Order was issued by the Ministry of Food. This Order becomes operative on January 1, 1918, and institutes a close control over the sale of the more important seeds The testing of samples in connection with the Order will be carried out in the new station, which is fully equipped for the purpose, and will further undertake the testing of seeds for farmers and allotment-holders at a nominal fee of threepence per sample, and for seed traders at half a crown per sample. The station is located at 70 Victoria Street, S.W.1, and is under the direction of Mr. R. G. Stapledon, advisory botanist of University College, Aberystwyth, who for some time has been actively associated with the work of the Food Production Department at headquarters. In declaring the station open, Mr. Prothero expressed the hope that in years to come there would be associated with it an Institute of Applied Botany, which would be of great service to agriculture.

AN interesting and important report of the Nitrate Supply Committee (appointed by the United States Secretary of War) is summarised in *Science* for September 14. The chief recommendations made are as follows:—That out of the 4,000,000*l*. nitrate supply appropriation the following sums be made available for the purposes indicated:—(1) 600,000*l*. to be used in building a synthetic ammonia plant (best in south-west Virginia or a contiguous region), contingent upon the completion of satisfactory negotiations with the General Chemical Co. for the rights to use its synthetic ammonia process; (2) 120,000*l*. to be placed at the disposal of the War Department for building a plant for the oxidation of ammonia to nitric acid and concentrating the latter; (3) 40,000*l*. to be allotted to

experimentation in the industrial development of the Bucher process for the production of sodium cyanide and ammonia, contingent upon a satisfactory arrangement being made with the Nitrogen Products Co.; (4) 20,000*l.* to be made available for the active prosecution of investigations into processes for the industrial production of such nitrogen compounds as are required in the manufacture of explosives and fertilisers. The committee further recommends that the War Department proceed with the construction of the plants mentioned under (1) and (2) above at the earliest practicable date, that the Government promote the installation of by-product coke-ovens in order to increase the production of ammonia and toluol, and that a decision regarding the more extensive installation of nitrogen processes be postponed until the plants now recommended are in operation. The committee is of opinion that the immediate accumulation and permanent maintenance of a reserve of Chile saltpetre of not fewer than 500,000 tons is a measure urgently necessary.

WE learn from *Science* that upon the recommendation of the U.S. National Research Council Dr. A. Trowbridge, of Princeton University, and Prof. T. Lyman, of Harvard University, have received commissions in the Signal Corps, U.S.A., for work in sound-ranging. They have sailed for France to investigate conditions at the front in this subject. The sound-ranging service which will be developed under their direction will utilise in the near future more than fifty men. A meteorological service has been organised under the Signal Corps, U.S.A., in which about one hundred physicists and engineers will be engaged in aerological observational work under the direction of Dr. W. H. Blair, of the U.S. Weather Bureau, who has sailed for France to investigate conditions abroad. Forecasting work for the American Expeditionary Force in France will be in charge of Mr. E. H. Bowie, of the U.S. Weather Bureau. Prof. C. E. Mendenhall, of the University of Wisconsin, has been placed in charge of the development of aeronautical instruments. All the work of these services, sound-ranging, meteorology, and aeronautical instruments, is included within the scope of the Science and Research Division of the Signal Corps, which, in accordance with a recent order of the chief signal officer, has been established and placed under the direction of the National Research Council, of which Major R. A. Millikan is the executive officer. The functions of this division of the Signal Corps are twofold, namely: (1) to furnish *personnel* of the research sort to the other divisions when the situation warrants the assignment of men of this type to these divisions, and (2) to have a *personnel* of its own which maintains intimate contact with all research and development work in other divisions, and distributes research problems to university, industrial, and governmental research laboratories with which it is associated. Similar, though in some cases less formal, relations have been established with other technical bureaux of the War and Navy Departments. Upon request of the French High Commission a number of American physicists and chemists are being sent to France to assist in various war problems in which technically trained men are needed. Upon the recommendation of the National Research Council Prof. R. W. Wood, of Johns Hopkins University, Prof. E. Bartow, of the University of Illinois, Prof. R. Stevenson, of the College of the City of New York, and other men of science are receiving commissions in this connection, and a number of them have already sailed for France.

THE Committee of the Loutreuil Foundation has reported to the Paris Academy of Sciences (*Comptes rendus*, October 22) that it has recommended the following grants:—The National Natural History Museum, 3000 francs to Prof. Louis Roule for assistance in his researches on the migrations of the Salmonidæ. Central Council of the Observatories: 8000 francs to the Observatory of Lyons for the installation of a telephone line; 1500 francs to Henry Bourget, director of the Marseilles Observatory, for assisting in the publication of the *Journal des Observateurs*. Ecole Polytechnique; 1000 francs to Prof. A. Colson for his physico-chemical researches on the theory of solutions. National Veterinary College of Lyons: 5000 francs for the installation of radiological apparatus; 350 francs to Prof. Charles Porcher for the purchase of apparatus for researches on milk. National Veterinary College of Toulouse: 5000 francs for the purchase of a projection apparatus capable of utilising kinematographic films. Conservatoire des Arts et Métiers: 5000 francs to Prof. Léon Guillet for the organisation of a metallographic laboratory. In reply to demands addressed direct: 5000 francs to Charles Alluaud and R. Jeannel; 1000 francs to Henri Blondel; 5000 francs to the Institute of Hydrology and Climatology; 2000 francs to R. Ledoux-Lebard and A. Dauvillier for their X-ray researches; 2000 francs to A. Paillot for the purchase of material required for bacteriological researches; 1000 francs to J. de Thézac; and 3000 francs to Albert Portevin and Marcel Garvin. The grants proposed amount to 47,850 francs, and the committee considers it necessary to carry forward a large balance, in view of probable demands at the close of the war.

PROF. J. A. FLEMING will deliver a Christmas course of six illustrated lectures (adapted to a juvenile auditory) at the Royal Institution, on "Our Useful Servants: Magnetism and Electricity."

A GENERAL meeting of the Geological Physics Society will be held in the rooms of the Geological Society, Burlington House, on Wednesday, November 28, at 3.30 p.m., at which a lecture will be delivered by Mr. C. Carus-Wilson on "Theories and Problems relating to Musical Sands," illustrated by experiments. The meeting will be open to visitors.

THE Thomas Hawksley lecture, 1917, of the Institution of Mechanical Engineers will be delivered at six o'clock on Friday, November 30, in the hall of the Institution of Civil Engineers, Great George Street, Westminster, by Capt. H. R. Sankey, who will take as his subject "Heat Engines." An invitation is given to visitors.

AT a meeting o. the Chemical Society held on November 15 the following exhibits were shown:—Laboratory glass apparatus and specimens of chemicals, by Messrs. Baird and Tatlock; laboratory ware, by Messrs. Doulton and Co., and by the Royal Worcester Porcelain Co.; specimens of dyes used in the clothing of the Armies of the Allies, and medicinal agents and antiseptics, by Messrs. Levinstein, Ltd.; balances and weights, by Mr. L. Oertling; and laboratory glass apparatus, by Messrs. Wood Bros. Glass Co., Ltd.

As the subject of the metric system was very fully discussed at the Institution of Civil Engineers in the early part of the year, especially from the point of view of the relative merits of that system and the British, it may be well to state that the main object of the discussion to be held at the Institution of Electrical Engineers on December 13 is to consider the effect on the British electrical trade of the introduction of the metric system at the present time, especially in those markets in which the British system is at present in vogue, with the view of determining whether the compulsory introduction of metrical measures should be pressed for or resisted. It is hoped

that it may be found possible to take steps after the discussion to obtain some authoritative pronouncement on the matter from the trade as a whole that will put an end to the present hesitating and unsatisfactory attitude towards the question.

We regret to record the death of Mr. Wilson Noble on October 31, at sixty-two years of age. Mr. Wilson Noble was a fellow of Trinity College, Cambridge. From 1886 to 1895 he was Conservative M.P. for Hastings. He devoted much of his time to electrical investigations, particularly in connection with X-rays, and having a very fully equipped laboratory was able to render great service in the medical applications of radiography in the early days of the discovery. He held the position of president of the Röntgen Society in 1900, and was the author of some important papers on X-ray technique.

News has been received of the sudden death last week, at fifty-nine years of age, of Prof. Emile Durkheim, the distinguished philosopher and sociologist, editor of the *Année Sociologique*, and professor of pedagogics at the Sorbonne. The loss of his only son, a young philosopher of great promise, in the fighting at Salonica at the end of 1915, and a long uncertainty as to his fate, had visibly affected Prof. Durkheim's health, but he was able to continue his courses to the end of the scholastic year. In November, 1916, a nervous breakdown obliged him to discontinue his work, and in spite of temporary improvements he never recovered.

2nd Lieut. L. P. Sidney, whose death, at twenty-four years of age, is reported in the *Times*, was an observer in the Royal Flying Corps. He was the son of Mr. L. P. Sidney, assistant secretary of the Iron and Steel Institute, and studied for a time at the National Physical Laboratory, Teddington, in the engineering department under Dr. Stanton, and in the metallurgical department under Dr. Rosenhain. On leaving Teddington he spent a year in iron and steel analysis with Mr. F. W. Harbord, and when the war broke out he was in the service of Messrs. Bell Brothers, Middlesbrough, as metallurgist.

We learn from *Science* that Mr. J. Y. Bergen, author of several well-known text-books of botany and physics, died at his home in Cambridge, Mass., on October 10, at sixty-six years of age. In 1887 Mr. Bergen became teacher of physics in the Boston Latin School, and later for many years he was instructor in biology in the Boston English High School. In collaboration with Prof. E. H. Hall, of Harvard University, he was the author of "A Text-book of Physics," which has passed through several editions. He was also the author of "Elements of Botany," "Essentials of Botany," and "Foundations of Botany," including a condensed flora for school use. Other successful text-books with special adaptation for schools of particular grades of scientific equipment were prepared by Mr. Bergen in collaboration with Dr. O. W. Caldwell and Prof. B. M. Davis.

The inaugural lecture in connection with the George Herdman chair of geology at the University of Liverpool was delivered by Prof. P. G. H. Boswell on Friday last, November 16. In a short introductory address, the Vice-Chancellor (Sir Alfred Dale), who presided, remarked that many of the University chairs were memorials of those who had done their work or whose work was nearly done, but the chair they were now inaugurating was one established in memory of youth, and of a work that was just begun. It had been established by Prof. and Mrs. Herdman in memory of their son, George Andrew Herdman, who fell rather more than a year and a half ago in France. He was young, and an undergraduate at Cambridge. But he had already given something more than mere promise, and older men who knew him regarded him as one who not only would maintain, but also might possibly increase, the honours he had inherited with his name.—The subject of Prof. Boswell's lecture was "Sands: considered Geologically and Industrially under War Conditions."

Sir W. T. Thiselton-Dyer has presented to the library of the Royal Botanic Gardens, Kew, a collection of about a hundred personal letters addressed to him by Charles Darwin between the years 1873 and 1881. Those of more general interest have been already published. In one he writes, "It is a dreadful evil to be so ignorant of botany as I am," and many of them contain allusions to experiments and discoveries of the utmost interest. These letters constitute a very valuable addition to the now extensive collection of original documents to the Kew Library.

We learn from *Kew Bulletin*, No. 6, that the island of Ascension has suddenly been clothed with verdure, a grass, *Enneapogon mollis*, having appeared in great abundance on the lower parts of the island. The account is illustrated by a photograph showing men cutting a luxuriant crop of the grass, which has converted what Sir Joseph Hooker described as a "scorched mass of volcanic matter, in part resembling bottle-glass and in part coke and cinders," into a comparative paradise. The grass, which is apparently an annual, has not been reported from the island before, but is a native of tropical Africa, and seeds may have reached the island through the agency of birds, or have been wind-borne. It appeared after some good showers, rain being of very rare occurrence in Ascension.

During the present war more use has been made of electrical treatment than at any previous time. Cases that are seldom or never seen in times of peace, such as shell-shock and trench-foot, are receiving their trial of electric treatment, as well as neurasthenia and various neuroses, so that more detailed information of the value of this form of treatment will be obtained. Cases of nerve injury are also numerous, and much experience is being obtained of the uses of electricity in their diagnosis and treatment. The *Archives of Radiology and Electrotherapy* proposes to publish reports from the electrical departments of various war hospitals, and in the October number (vol. xxii., No. 5) an account is given by Lieut. Burke of that of the Horton War Hospital, Epsom. The report of the Radium Institute of work from January, 1915, to December, 1916, is also included. Of 580 cases of cancerous disease treated (excluding rodent ulcer) twenty-six were apparently cured.

The West Indian colonies, in common with the rest of the world, have their bread problem. How this is to be met is the subject of an official inquiry, and an interim report of the British Guiana Flour Substitutes Committee, published in the Bulletin of the Department of Agriculture, Trinidad and Tobago (vol. xvi., part 2), indicates the lines upon which action can be most usefully taken. Analyses collated by the committee show that the products of tropical origin which most nearly approach wheat flour in food value are rice, guinea-corn, and maize. These materials can be employed alone only in the preparation of cakes. Without wheat flour they do not give a satisfactory bread. Other products of relatively higher starch content which are of local origin, *e.g.* cassava, sweet potatoes, tannias, and eddoes, can also be employed in this way, but they yield an article of lower food value and wider nutrient ratio. It is possible, however, by the addition of a proportion of meal obtainable from

locally grown pulses, *e.g.* pigeon-peas, black-eye peas, lima, and bonavist beans, to bring the nutrient ratio of these more starchy products up to the desired standard. Action upon these lines is recommended, and a proposal is put forward for the establishment of a factory, or factories, for converting the locally grown raw materials into non-perishable and marketable products. The same number of the bulletin contains also papers by Mr. R. O. Williams and Mr. H. Meaden, in which more detailed information on the various suggested flour substitutes is given.

SINCE the war began it has become apparent that the resources of the Empire in food and raw materials have not hitherto been used to meet the needs of the Empire itself to anything like the extent that is desirable. Rice is a striking example of this state of things. Thus India, which produces (principally from Burma) about 40 per cent. of the world's exportable surplus of rice, distributed its exports in 1913–14 in the following proportions: to British countries 42·6 per cent., to foreign countries 57·4 per cent. The gross imports into the British Empire were little less than the total exports of rice from India, so that it would be quite possible to find a market within the Empire for nearly all the rice India can spare for export. While this country occupied a relatively unimportant position as a direct importer of rice from India, it imported considerable quantities of rice from Holland and Germany, which had been first exported from India to those countries, and, after being milled and polished there, had been re-exported to England. It is clear that there is much leeway to make up in the way of developing inter-Imperial trade in food and raw materials. In the new number of the Bulletin of the Imperial Institute is published an exhaustive article on the "Production and Uses of Rice" (British literature on which subject has hitherto been practically non-existent), which, it is hoped, will assist in that direction. It gives precise information as to the present production of rice throughout the world and the demand for this grain within the Empire, the general tendencies of the trade, the directions in which markets should be sought, and various uses to which rice is freely applied in certain countries, though not, as yet, within the Empire.

IN a paper on the testing and standardisation of motor fuel, read at the Institution of Petroleum Technologists on October 16, Mr. E. L. Lomax described an improvement of the Engler process for determining the degree of volatility of motor fuels. The method consists essentially in the adaptation of a jacketed dephlegmator column to the usual apparatus, and is designed to give results similar to those obtained by the original method of distillation, but with greater rapidity and easier manipulation. In connection with this subject attention is directed to the gradual change in the composition of motor-spirits corresponding with the development of motor engines during the last decade. Whereas formerly the average proportion of these spirits volatile below 100° C. was about 60 to 70 per cent., it is now only about 20 to 40 per cent., with a correspondingly greater proportion of higher boiling hydrocarbons. This is important, since it means that motor engines have been so improved that they can utilise more of the heavier fractions of petroleum than formerly; the present-day automobile engine will run quite well on spirit which would have given much trouble with the engine of earlier days. It is for motor engineers to see that the engine of the future will run well on even a less volatile mixture than that now employed. The world's supply of petroleum products suitable for use in internal-combustion engines is strictly limited, and development on the lines indicated is one of the means by which the petroleum industry may be enabled to meet the growing demands. At the present time it is a waste of valuable products to use spirit containing an unduly large percentage of the more volatile compounds for road and water vehicles, as these light fractions assist the vaporisation of heavier hydrocarbons which are not by themselves satisfactory fuels for internal-combustion engines, but which can be used for the purpose when mixed with the lighter fractions. Thus utilised, they serve greatly to increase the available supplies of motor fuel.

ALTHOUGH the calls made on the services of the National Physical Laboratory for work connected with the war during the past two years have been exceptionally heavy, the appearance of vol. xiii. of the Collected Researches of the Laboratory shows that research work has not been neglected. The volume extends to 300 pages, and includes researches from the Froude tank, the engineering, metallurgical, optical, and magnetic departments. More than half the total number deal with optical questions of vital importance to the instrument-maker. Some of these describe new methods which instrument-makers have already adopted, while others provide material for future use. A paper on tests of fuel oils made for the Royal Commission on Oil Fuels by Messrs. Pannel and Higgins appears not to have been published previously. It deals with the flow of Mexican, Texas, Trinidad, and Scotch shale oils, and of mixtures of them through pipes of various diameters, and shows that the pressure head necessary to give a prescribed flow can be determined by the expression which has been shown to hold for the flow of water or air through pipes of different diameters. The viscosities, densities, and flash points of the above oils, and of Borneo, Persian, and Kimmeridge shale oils, and of their mixtures, were also investigated, and the advantages of certain mixtures are pointed out.

La Nature for October 27 gives some particulars of the Institute of Applied Hydraulics which has recently been inaugurated by the University of Padua. The new institute is situate at Stra, on the Padua-Venice tram route. A villa has been taken and converted into laboratories, which are provided with the usual equipment, lecture-rooms, etc. Facing the building is a long canal, which has been transformed into an experimental tank, along which runs the electrically driven carriage. The tank is 200 metres long, 10·75 metres wide at the surface, and 3·5 metres deep. Researches have already been carried out in the tank on the flow of water in tubes of various cross-sections and diameters under constant or slowly varying pressures, the motion of water in forced conduits such as are used in hydraulic plants, and so on. A tower specially erected near the main building produces a head of water for experimental purposes, *e.g.* determining the influence of change of shape of pipe and the nature of its walls, and the strength of materials used in structural work. Investigations are at present in hand on the value of the instruments used for measuring flow, such as Pitot tubes and the Woltmann mill, and the influence of their length, depth of immersion, etc., on the accuracy of measurement. The new Hydro-technical Institute will publish a bulletin periodically setting forth researches undertaken, together with the results attained. The institute will also keep in close touch with the Hydrographic Department at Venice, and thus be able to supply any information required bearing on the protection of that city from floods and the study of the lagoons along the Adriatic.

THE whirling of shafts has occupied the attention of many engineers during recent years, and a series of articles by Mr. H. A. Webb, which appears in *Engineer-*

ing for November 2, 9, and 16, will be read with interest, as it forms a valuable contribution to our knowledge of this subject. Mr. Webb has evolved a graphical method of solution for non-cylindrical shafts, in which a graph of $\sqrt{I/w}$ is drawn for the shaft, w being the weight per unit length, and I the moment of inertia of the section in bending. The whirling speed can then be estimated roughly from a set of typical curves included in the paper, or can be calculated by employing graphically Mr. Webb's two formulæ. For the purpose of checking the new method, a number of new solutions has been found by rigorous mathematics. These cases include a cylindrical shaft, a solid shaft consisting of one or more conical pieces, a hollow shaft with all its weight in the rim, and consisting of one or more conical pieces, and a solid shaft the meridian curve of which consists of one or more parabolic arcs, all of them, produced if necessary, touching the axis. For all cases the agreement is remarkably close, and shows that the new graphical method is valid if (maximum value of Iw)/(minimum value of Iw) is less than 40,000, which limit probably includes all shafts likely to be required in practice. Mr. Webb's method is based on a hitherto unpublished approximate method of attacking the general problem devised by Mr. W. H. Barling some years ago. Mr. Barling's hypothesis is that there is no transference of energy between consecutive elements of the shaft, and it gives correct results for cylindrical shafts.

MESSRS. J. M. DENT AND SONS, LTD., will shortly publish "A Complete System of Nursing," by Miss A. M. Ashdown. It is claimed for the work that it will contain all the practical information which a nurse may require during her training and in actual practice.

MESSRS. DULAU AND CO., LTD., 37 Soho Square, W.1, have just issued a valuable and interesting catalogue (No. 69, November) of more than 1600 works on Botany (Phanerogams and Cryptogams), Zoology (Vertebrates and Invertebrates), Herbals, Gardening, and Agriculture. Many of the books offered for sale are rare, and a considerable proportion, being of foreign origin, are difficult to obtain in a new condition at present. The catalogue should be of service to many of our readers.

IN the article on "Ferro-Concrete Ships" which appeared in last week's NATURE, it should have been stated that we were indebted to *Engineering* for the blocks with which the article was illustrated.

OUR ASTRONOMICAL COLUMN.

ORBITS OF COMETS.—The orbits of three comets are discussed by S. Ogura in *Annales de l'Observatoire Astronomique de Tokyo*, tome v., part 3. (1) Comet 1827 II. was discovered by Pons on June 20, 1827, and observed by him for a month; Pons used a ring micrometer, and his observations show rather large residuals. The definitive orbit is as follows:—

$$\begin{aligned} T &= 1827 \text{ June } 7{\cdot}192422 \text{ G.M.T.} \\ \left.\begin{aligned} \omega &= 19^\circ\ 18'\ 56{\cdot}12'' \\ \Omega &= 317^\circ\ 39'\ 39{\cdot}67'' \\ i &= 136^\circ\ 26'\ 11{\cdot}00'' \end{aligned}\right\} & 1827{\cdot}0 \\ \log q &= 9{\cdot}9067087 \\ \log e &= 9{\cdot}9774915 \\ \text{Period} &= 63{\cdot}83 \text{ years} \end{aligned}$$

The period is considered to lie between fifty-nine and sixty-nine years. The orbit of the comet of 1500 shows a distant resemblance, but identity is improbable.

(2) The comet of 1132 was observed in Japan on October 5, 7, and 9; its motion was extremely rapid, 100° being described in four days. The following orbit is deduced:—

$$\begin{aligned} T &= 1132 \text{ August } 30{\cdot}20 \text{ G.M.T.} \\ \left.\begin{aligned} \omega &= 114{\cdot}3^\circ \\ \Omega &= 201{\cdot}1^\circ \\ i &= 106{\cdot}4^\circ \end{aligned}\right\} & 1132{\cdot}0 \\ \log q &= 9{\cdot}8666 \end{aligned}$$

These elements indicate a near approach to the earth, the distance being 0·045 on October 7. This comet was also observed in China and Europe, but the positions are less precisely defined than in the Japanese record.

(3) The comet of 1240 was observed with considerable precision in Japan; it passed close to Jupiter, and the head was stated to be "as big as Venus." The following orbit is deduced from the Japanese and Chinese observations:—

$$\begin{aligned} T &= 1240 \text{ January } 21{\cdot}06 \text{ G.M.T.} \\ \left.\begin{aligned} \omega &= 331{\cdot}3^\circ \\ \Omega &= 124{\cdot}5^\circ \\ i &= 75{\cdot}4^\circ \end{aligned}\right\} & 1240{\cdot}0 \\ \log q &= 9{\cdot}8246 \end{aligned}$$

The minimum distance from the earth was 0·36 on February 2. The orbit somewhat resembles that of comet 1863 IV.

THE IRON ARC AS A SOURCE OF STANDARD WAVE-LENGTHS.—Previous investigations have shown that the wave-lengths of many of the lines in the spectrum of the iron arc, which is in such frequent use as a source of standard wave-lengths, are subject to variations depending upon proximity to the electrodes. The possible elimination of this "pole-effect" has been the subject of an important investigation by Messrs. St. John and Babcock (*Astrophysical Journal*, vol. xlvi., p. 138). It has been shown that the effect disappears in the case of the Pfund arc *in vacuo*, and becomes negligible in a narrow central zone of the same type of arc in air when the negative pole is of carbon. The former, however, is not a convenient everyday source, and the latter is lacking in intensity. The practical outcome of the extensive experiments is to show that a Pfund arc, with both poles of iron, may be relied upon to give the "fundamental" wave-lengths of even the most sensitive lines, if the length of the arc be not less than 8 mm. and the current not more than 5 amperes; under these conditions a horizontal zone near the centre at least 1¼ mm. wide may be used with safety. This arc also has the advantage of giving sharply defined lines, and uniformity in the relative intensities. The investigation has shown that the pole effect has not been entirely eliminated in the case of the adopted international standards, and that certain supposed anomalous displacements of iron lines in the sun become normal when the fundamental wave-lengths of such lines are used for comparison.

CAPE OBSERVATORY REPORT.—The report of his Majesty's Astronomer at the Cape of Good Hope for 1916 has been received. Besides work of a more or less routine character, we note that a new programme of observations of close circumpolar stars with the reversible transit-circle has been undertaken, with special reference to the determination of the constant of aberration. Mr. J. Voûte has completed his series of observations for stellar parallaxes by means of right ascension measures, and has also made observations of double stars. The programme of observations for radial velocities of stars with the Victoria telescope and four-prism spectrograph was completed before the end of the year, and experiments with a shorter camera are in progress with a view to the extension of the observations to fainter stars. Photographs of the sun, intended to supplement the Greenwich series, were

obtained on 333 days; when possible, duplicates were taken at short intervals for the detection of spots of brief duration. In addition to the usual system of telegraphic time-signals, arrangements have been completed for the daily transmission of a wireless signal for the use of shipping in South African waters.

THE CLASSIFICATION OF THE BRITTLE-STARS.[1]

THE Ophiuroidea have long presented a problem to the systematist, and its solution was not advanced when the palæontologist joined the neontologist in council. The reason is twofold: the modern representatives of this Echinoderm class differ little in great points, but greatly in little points; the Palæozoic representatives, which do differ much, and should throw light on the origins of orders, are so preserved as to be difficult of interpretation. Twenty-five years ago Mr. Jeffrey Bell divided the recent forms according as they could only move the arms horizontally or could also coil them vertically, the latter being regarded as more primitive. Dr. J. W. Gregory extended this system by adding an order for those yet more primitive forms in which the arm-bones still consisted of the original paired elements. It was early pointed out that these divisions represented successive grades rather than divergent orders; but doubt has since been cast even on their correspondence with reality by the observations of Schöndorf, Sollas, Mortensen, and Spencer on the older fossils and on the crucial genus Ophioteresis. Now a voice from the East complains: "I found the classifications very unsatisfactory. Indeed, their imperfections became a haunt to me." From a study of recent genera, Mr. Matsumoto infers that in respect to both mouth-frame and arm-bones the forms which can only move their arms horizontally are more primitive than those which can coil them vertically. He therefore rejects any system based mainly on the joint-faces, and puts forward a classification of his own.

The difficulty presented by the Palæozoic forms is evaded by separating them as a sub-class: Œgophiuroida. Since this admits no genera with ventral arm-plates it cannot quite correspond with the Palophiuræ (Haeckel), but its difference from the Protophiuroidea (Sollas) is not obvious. Neither is it clear whether the author would regard the Œgophiuroida as a non-persistent group parallel to both Asteroidea and Ophiuroidea, or whether he would bring it into the ancestry of modern brittle-stars.

All normal Ophiuroidea with the ventral surface of the arms covered by plates are constituted a sub-class Myophiuroida. Its Palæozoic representatives have no distinct plates in the skin of the central disc, the mouth-frames are slender, dorsal arm-plates are absent or incipient, ventral arm-plates are small and depressed below the projecting edges of the side plates. Among recent forms it is the Ophiomyxinæ that come nearest to this condition, but it is also approached by those Ophiacanthidæ in which the arms are only flexible horizontally. From the Ophiomyxidæ Mr. Matsumoto derives all the Trichasteridæ and Gorgonocephalidæ, and separates the three families as an order Phrynophiurida.

From the early Ophiacanthidæ are supposed to spring all the other Ophiuroids, diverging along three lines. The first of these passes, through those Ophiacanthidæ which can coil the arms vertically, to the Hemieuryalidæ; and these two families compose the order Læmophiurida. The two other lines never attain vertical coiling. From one another they are distinguished in the articulation of the radial shield and genital plate: in the one case this is by a single ball-and-socket joint, in the other case by two condyles and sockets. The former line passes, through the Amphilepididæ, to the Amphiuridæ and Ophiotrichidæ, and, since these two families have stout mouth-frames and teeth, the whole order is called Gnathophiurida. Along the other line arises a host of forms, divergent in structure and complex in relationship, which are grouped under five families: Ophiodermatidæ, Ophiochitonidæ, Ophiocomidæ, Ophiolepididæ, and Ophioleucidæ.

Mr. Matsumoto's classification, being essentially phylogenetic, will have to be checked by the palæontologist before it can be considered established. The morphological bases, however, seem well selected and are well illustrated.

F. A. B.

[1] "A Monograph of Japanese Ophiuroidea, arranged according to a New Classification." By Hikoshichiro Matsumoto. Journ. Coll. Science, Tokyo, vol. xxxviii., Article 2. Pp. 408+vii plates. (University, Tokyo, March 31, 1917.)

ATMOSPHERIC POLLUTION.

THE second report (1915–16) of the Committee on Atmospheric Pollution has just been issued in the form of a supplement to the *Lancet*, the delay in its appearance being due to lack of funds. This difficulty has now been met by the receipt from the Department of Scientific and Industrial Research of a Government grant, which provides the necessary equipment for collecting and analysing the smoke deposits at different centres. The work, moreover, has been given official approval and status by placing it under the control of the Meteorological Office, the committee being constituted as an advisory committee of that department.

Owing to the depletion of the staffs formerly collaborating in these investigations, certain stations have found it impossible to continue observations, so that the list for the year is curtailed. The general methods of analysis and tabulation of results are, with slight modifications, those previously described in the former report (NATURE, May 4, 1916, vol. xcvii., p. 203).

It is interesting to note from the point of view of fuel economy that the deposit for the year in the County of London alone, which consisted of matter derived from waste fuel in the form of smoke, amounted to 54,200 tons. The report adds that not only is it necessary to scrutinise carefully every source of waste, but it is equally necessary to conserve the health and physical energy of the people. From this point of view it refers to the fact that the average weight of air consumed per day by the adult human being is 30 lb., as compared with 7·2 lb. of solid food and water.

In the section devoted to a discussion of results a comparison is drawn between the total solids deposited in the six summer and the six winter months of 1915–16 with the corresponding periods of 1914–15. Without reproducing details of the results it may suffice to say that in the larger number of centres there has been an increase in the amount, a few centres in the Manchester and Glasgow area showing a decrease in the winter months, while Birmingham Central, Bolton, Malvern, Sheffield, and York show a diminution in the summer months. Of the actual quantities, the mean monthly deposit in tons per square kilometre is tabulated for the different centres. It appears from this that Oldham has the distinction of showing the largest deposit of total solids, carbonaceous matter other than tar, and insoluble ash, while Glasgow occupies the highest place in ammonia, sulphates, and tar. Malvern shows the minimum deposits in nearly every item. If there were the same fierce rivalry between towns as existed in medieval Italy, we might hope that industrial centres might vie with Malvern in improving their atmosphere.

There seems very little prospect of any such peaceful

solution of the problem of smoke pollution. Yet this problem in industrial and sanitary reconstruction will have to be faced when peace comes, and for that reason it seems unfortunate that the Local Government Board Committee on Smoke Abatement should have indefinitely postponed its meetings on the outbreak of war.

J. B. C.

METEOROLOGICAL PERSISTENCE.

THERE is a special sense of appropriateness about the brochure entitled "Konstant auftretende secundäre Maxima und Minima im dem Jährlichen Verlauf der meteorologischen Erscheinungen," by Dr. Eli Van Rijckevorsel, published as No. 102 of the "Mededeelingen en Verhandelingen" of the Royal Meteorological Institute of the Netherlands. For the last dozen years the author has appeared to confine his published scientific activity to the subject of the persistence of secondary maxima and minima in annual meteorological phenomena, and this is his eleventh contribution on the same thesis, the last three of which have received the support of his national institute.

A detailed comparison of the whole series of "tracts" would be necessary to enable us to dogmatise as to the validity of the author's conclusions and the justification of his persistence. There is no doubt, however, that even this eleventh article taken by itself is full of interesting points. A long series of seventy-two years' barometric data from Christiania is dealt with in two thirty-six-year portions, and also as to twenty-five years allocated to sun-spot maxima and twenty-five years to minima in the same period. From the sun-spot point of view, a similar process is applied to shorter periods from Nertchinsk and Innsbruck. The main part of the data, however, consists of daily sums from thirty-three stations in the N. Hemisphere for periods ranging from forty-three years at Haparanda to four at Honolulu and St. Vincent (Cape Verde). The stations are well distributed, five with a mean latitude of 67° and a range in longitude of nearly 100°; eight with mean latitude 52°, and with gaps in longitude of 120° for the Pacific and 90° for the Atlantic; nine with mean latitude 42°, and again a gap of 120° in longitude for the Pacific; and eleven with mean latitude 21° in which the Pacific gap is partly bridged by Honolulu. Some of the tables appear to have had a decimal point omitted throughout, and the Honolulu table differs considerably from the others, but the principle of printing sums instead of means, when the periods vary considerably, seems to demand more explanation than the author has given, though this practice has probably been adopted and discussed in one of the ten earlier contributions which are not for the moment at hand.

An excellent series of plates shows the author's idea of the variation with latitude and longitude of the secondary oscillations with which he is dealing, and there is also a comparison of the resulting oscillations from a fifty winters' comparison of Greenwich barometer and thermometer, showing a mean lag of half a week from the barometric maximum to the temperature minimum; a similar comparison in diagrammatic form is given for Bucharest from a fifteen-year period.

Altogether there would appear to be thirty-five oscillations in the year superposed on the ordinary single solar oscillation, but having regard to the classic case of the three "icemen," now so generally discredited in this country, it may be some time before Dr. Rijckevorsel obtains much enthusiastic support among us, for though the reality of the alternations of weather is undeniable, our proverbial traditions nearly all postulate, not the same, but different conditions on a fixed date.

W. W. B.

THE SHORTAGE OF THE SUPPLY OF NON-PHOSPHORIC IRON ORE.[1]

ALREADY in the pre-war years the supplies of high-class hæmatite to the iron-smelting districts of Europe from the nearer sources were getting short, and the time was in sight when, for iron ores low in phosphorus such as are required for the production of the "hæmatite grade" of pig-iron demanded by those who make steel by the "acid" process, we shall have either to turn our attention to sources of supply which are less readily accessible, or so to improve metallurgical processes that, from ores which are abundant in closer proximity to the coalfields, trustworthy substitutes for "Bessemer-grade" acid steels can be economically produced. The thesis advanced by the author of these Howard lectures is that, notwithstanding that the low-grade phosphoric ores of the English Jurassic rocks yield a pig-iron which for steel-making requires refining upon a basic hearth, in Britain the second of the two alternatives mentioned should be chosen.

The subject-matter dealt with in the lectures was assembled under two heads. In the first of the lectures the author presented a conspectus of the various ironfields where ore production is in progress within the British Isles. In the second he passed in review the various orefields in foreign countries which, under peace conditions, sent produce, either raw or semi-manufactured, from their iron mines to supply the British market.

Within the British area there is a remarkable absence of any considerable concentration of iron ore among geological formations of pre-Carboniferous age. The non-phosphoric hæmatites of the Carboniferous Limestone district occur as veins and impregnations, and extend some little distance downwards among these older rocks, but in their distribution they are limited to a narrow belt of country which ranges north and south through the English Lake District and the Forest of Dean, and are probably of post-Carboniferous date. They are less regular in their distribution, and therefore more expensive to exploit, than are the bedded ores associated with the Coal Measures or interstratified in thicker masses among the Jurassic rocks, and the shortage of home supplies of hæmatite has already long been felt.

In former days clay-band and black-band ores, interstratified among the Coal Measures, afforded the main supply of English and Scottish iron, but when steel superseded wrought-iron as the ordinary material for constructional engineering, economic conditions brought about the diminution of iron production from these ores, and though there lie in reserve more than thirty thousand million tons of such ore among our Coal Measures, that source of supply does not at present represent to our ironmasters a national asset which has any great marketable value.

Along the outcrop of the English Jurassic rocks between the coast of Dorset and the Cleveland Hills there is nowhere any lack of low-grade iron ore. In the neighbourhood of the Humber it is the Lower Lias which carries the ore-bed, but generally the Middle Lias is the more prolific horizon. In Northamptonshire the great development of iron ore is in the basal member of the Inferior Oolite series, and at Westbury, in Wiltshire, and throughout the southern counties, the most important development is in association with Corallian rocks. "Just as the Carboniferous is the great repository of Great Britain's fuel wealth, so the Jurassic is the bank which holds our fluid reserves of iron ore. The gilt-edged securities of Cumbrian hæmatite are sound, but not unlimited in amount;

[1] Abstract of the Howard Lectures delivered before the Royal Society of Arts on April 30 and May 7 by Prof. W. G. Fearnsides, Sorby Professor of Geology in the University of Sheffield.

while the market for the vast quantities of the clay-band and black-band ores of the Coal Measures must needs be written off. Our engineers prefer the produce of the hæmatite, but there is a shortage, and the price is therefore high. There is plenty of the low-grade phosphoric ore available and cheap. Surely it is not beyond the skill of our metallurgists to make use of it, and obtain from it a product which, on its merits, will overcome the prejudice of the British engineers. This is the only domestic solution of the problem of the home shortage of non-phosphoric iron ore."

Probably it has been realised by few that the total quantity of metallic iron obtained from iron ore

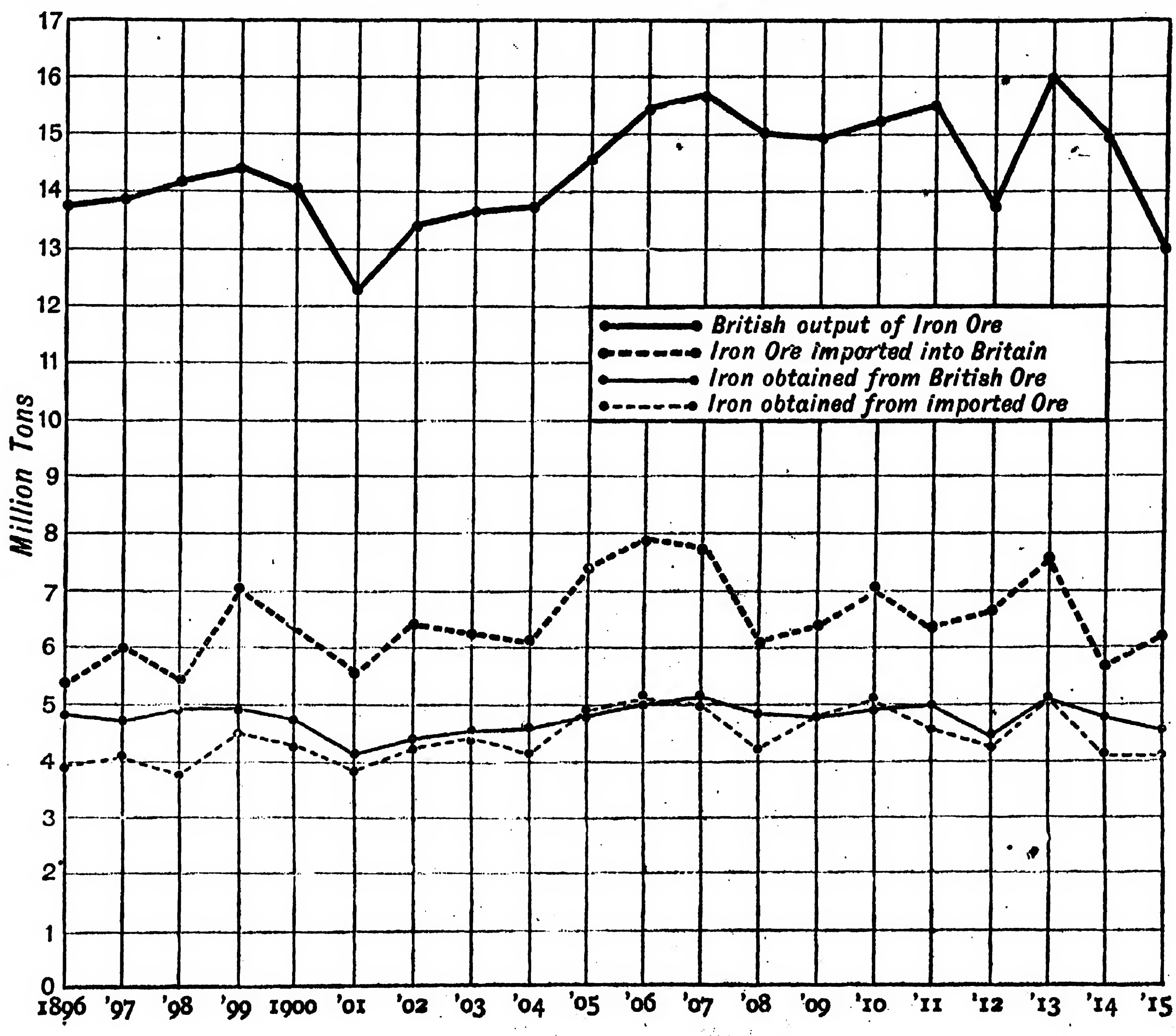

FIG. 1.—Curve showing British output of iron ore and iron obtained from British and imported ore.

brought by ship to Britain, *plus* the weight of metal imported in the semi-manufactured state, has for twenty years past been in excess of the quantity smelted from ores wrought in British mines and quarries. Iron ore, as imported, is generally a fine, selected, high-percentage ore, but in the average of home ores the percentage of iron is compulsorily low, and the tendency is downwards, the average percentage of metallic iron contained in them having declined from 34·7 to 32·1 in the course of the last twenty years. In the year 1913 the cost of turning sixteen million tons of British ore into 5·1 million tons of pig-iron was 17·1 million pounds, and the cost of turning 7·4 million tons of imported ore *plus* 0·6 million tons of "purple ore," *plus* a small amount of scrap steel turnings and mill-cinder, into 5·1 million tons of pig-iron was fifteen million pounds, an advantage in favour of the foreign ore of 2·5 million pounds. The cost of the British ore at mine was 4·5 million pounds, and that of the foreign ore delivered at British ports seven million pounds, between which figures there is also a difference of 2·5 million pounds, so that the difference in cost of manufactured pig-iron made from home and from foreign ore is inconsiderable.

In the pre-war years the demand for hæmatite among the ironmasters of the Rhineland was, as in Britain, on the increase, and in consequence the centre of gravity of the hæmatite supply showed signs of a gradual shifting southwards and eastwards. In the future, rising demand and heavier freights, due to increasing length of rail and sea passage, are likely to secure a continuously upward trend in the price of hæmatite, and though the first call for it will surely remain with the nation which wields the trident of sea supremacy, a time is coming when hæmatite obtained from scattered ore bodies will be unable to compete against the large and cheaply worked bodies of phosphoric ores of regions more convenient to the coal.

During the last decade many of those famous iron-ore bodies occurring in association with limestones equivalent in age to the upper part of the English Gault, which were opened up close to Bilbao, in northern Spain, early in the 'eighties, have become exhausted, and at the pre-war rate of depletion the known ore reserves of that district could scarcely have lasted more than another score of years. Other valuable metasomatic hæmatite masses have been discovered further to the westward, along the Pyrenean chain, and only wait for development until better means of transport to seaboard are provided. In southern Spain the present century has seen the beginning of active development of iron mining, and in the pre-war year an output equal to more than half that from Bilbao was thence exported.

The metasomatic hæmatites of Algeria, Tunis, and Morocco follow the foothills of the Atlas range. The well-known mass at Beni Saf promises to become exhausted if worked at pre-war rate for another half-dozen years, but other high-class ore bodies have been discovered along the line of the same unconformity,

where Mesozoic sediments rest upon the ancient schists and gneisses, and are ready for exploitation when railway facilities are provided. In Tunis the ores worked are often manganiferous, and some of them, though apparently true hæmatites, carry more than a trace of phosphorus.

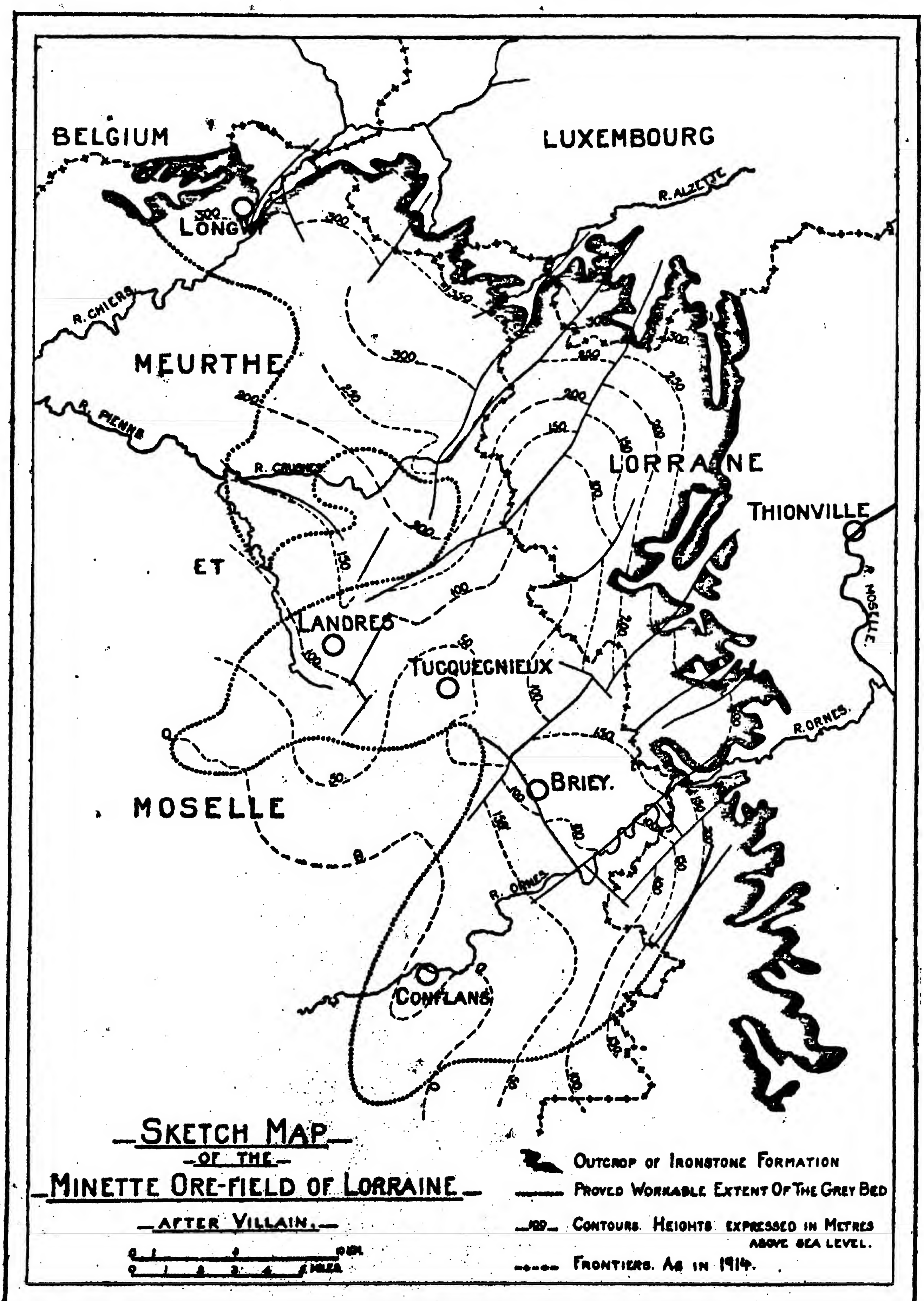

FIG. 2.

Hæmatite masses formerly worked on the island of Elba and on various of the Grecian islands in the Ægean Sea are either exhausted or likely to become exhausted, if quarried at the pre-war rate, within the present generation.

Produce from the Minette orefield of Lorraine has generally been converted into metal in Germany, Belgium, or France before it reached Britain, and, in consequence, the great importance of this orefield as a source of supply to British markets is often overlooked. It would appear that certainly far more than a million tons of metal brought into this country in each of several of the pre-war years might be traced back to a source of origin in the bedded Jurassic sediments of Lorraine. For the smelting of each ton of this imported metal, probably at least three tons of ore and two tons of coal (from the Hercynian belt of coalfields) must have been consumed, and it therefore appears that for quantity of mineral mined to supply the British market the area taken from France by Germany since 1870 must have held a place equal to, if not in front of, the ironfields of Spain. The iron ore wrought in Lorraine occurs as a series of beds, interstratified among Allenian (Toarcian) shales and limestones, almost identical in age with the Northamptonshire iron ores. The outcrop of the Minette formation extends from the southernmost tip of Belgium through the borders of Luxembourg with France and German Lorraine, southwards at an average distance of about three miles inside the 1914 German border as far as Metz, and crosses into France just east of Nancy.

Of the workable orefield about 160 square miles lie on the German side of the border, fourteen square miles in Luxembourg, and 208 square miles on the French side. The "Grey Bed" ores from French Lorraine are almost perfectly self-fluxing in the blast-furnace, and yield a pig-iron particularly suitable for steel-making by the basic process. According to German authorities, quite the best of the ore comes from the deeper mines beneath the Briey plateau, and had not the German ironmasters been bound by agreement to continue the payment of royalties to the owners of minerals in Germain Lorraine and Luxembourg, they would have abandoned these workings in their own

country and smelted the bulk of their pig-iron from the produce of the Briey mines. Since the late 'eighties, with the perfecting of the basic process the Lorraine district has established itself as the source of the cheapest supply of steel in Europe, and in the pre-war year the output from it was not much short of fifty million tons of ore. From German Lorraine about 300 out of 2000 million tons, and from France about 200 out of 3000 million tons proved, are won. "Truly, the Lorraine iron-ore district is an asset of the highest national importance, and there can be no doubt that, when official Germany has allowed rumours of her arrogant peace terms to be bruited, the industrialists of the Rhineland are at one with the military caste of Prussia in classing Briey and Longwy as essential strategic points."

Despite their nearness to the ports of Britain, the orefields of western France have not received from British ironmasters the attention they deserve, and more than two-thirds of their produce was, in the pre-war years, exported to Germany. The ironstone formation there is of Upper Arenig (Llanvirnian) age, and somewhat phosphoric in character. In the Normandy district, within sixty miles of the port of Caen, an ore reserve exceeding 200 million tons has been already proved, and the output of the mines of that district is expanding rapidly. The more southerly region north of the mouth of the Loire, in Anjou and Brittany, is as yet less well developed, but there is great hope of discovery of abundant rich ores of quite similar type. Western France is dependent upon English coal for fuel, and it is argued that vessels carrying coal thither should bring return cargoes of iron ore to British blast-furnaces.

For the production of "Swedish iron" the magnetite ores of central Sweden are generally selected by hand, or, after crushing, are concentrated by the wet magnetic process and briquetted. The supply of non-phosphoric magnetite in Sweden is very limited, and the immense magnetite lenticles of Norbotten, in Lapland, are of far greater importance to the Swedish export trade. The ore mass of Kirunavaara is one of the largest in the world, and is more than five miles long. In general, this, as also the other Lapland magnetite masses, carries a good deal of fluor-apatite, and being very dense requires a strong coke to carry its burden in the blast-furnace. For this reason, and because the produce from the Lapland mines requires to be converted into steel by way of the basic process, more than four-fifths of the ore exported from Sweden has found its market in Germany and Belgium.

In Norway the ore masses associated with the ancient schists are generally of lower grade than those of Sweden, and require to be crushed, concentrated, and briquetted to make them suitable for export, and few of the mines have yet advanced to the producing stage. From Sydvaranger, near the shores of the Arctic Ocean, on the borders of Russia with Norwegian Lapland, crushed ore is being successfully concentrated and exported. Some hundred million tons of available low-grade magnetite have been proved there lying in reserve.

Previous to the war produce from the orefields of North America affected the British market rather as a commercial competitor in outside markets than as an alternative source of supply. Since the outbreak of war, however, the British metal market, in former times largely supplied from the orefields of Lorraine, has had to replace its stock with steel and iron smelted in America from American ores. The "banded jasper" ironstone formations occur in the midst of Algonkian and Archæan sediments in the region of the Great Lakes, and segregation of specular iron ore in these formations has taken place along belts determined by tectonic folding. Largest of all the ore bodies in America are those of the Mesabi range, which district is responsible for nearly two-thirds of the total U.S.A. production. For magnitude of present output, as for gross quantity of metal yielded in the past, the Lake Superior region holds precedence over all the ironfields of the world. The available reserves there are enormous, and have been variously estimated at between 2000 and 3500 million tons, with a further 70,000 million tons of lower-grade specular material also in view. The Clinton oolitic ironstone of Silurian age in the eastern States has many features in common with the Minette series of Lorraine. It is worked extensively in the Birmingham district of Alabama, and as a producer of basic pig-iron its importance is increasing rapidly.

The ironfields of the Overseas Empire are separated from home furnaces by distances too vast for it to be economical to bring so low-priced and bulky a commodity as iron ore to compete with the produce from ironfields in the European countries which have no coal. In Canada, Australia, South Africa, New Zealand, and India, iron is already being smelted at a cost less than it can be brought in from Europe, and in due course we may expect to see local iron industries develop, perhaps to such an extent that outlying portions of the Empire may send manufactured or semi-manufactured metal to supply the British market.

Among the world's great ironfields which are supplying their raw material to the iron and steel industries only those in which the ore is to some extent phosphoric have been able since the beginning of the present century to increase their output on an extensive scale. The development of iron-mining in the various European countries and in America is shown on the diagram, Fig. 3.

The chief natural advantages which have enabled this country to outbid foreign rivals in the overseas markets for non-phosphoric hæmatite are the native wealth of the home supply of fuel, and the accident of geography which sited our magnificent coalfields near the harbours of our coasts. The high quality and cheapness of the fuel have enabled this country to maintain the supremacy of its mercantile marine throughout the age of steam, and this has been the dominant factor in securing to our ironmasters their ample hæmatite supplies. Meanwhile, the Germans, drawing the bulk of their ore supplies from deposits in closer proximity to their coalfields, have been able at very low prices to put on the market steel which is sufficiently satisfactory made from the Minette ores of Lorraine; and in the markets of the world this product has largely supplanted the lower grades of acid steel. British ironmasters, who were the last to feel the pinch of hæmatite shortage, have foreseen little commercial advantage to be obtained by smelting the cheaper low-grade supplies of home phosphoric ores, and have been reluctant either to reorganise or to extend their works in order to compete for low-grade trade, and only for high-quality tool and special alloy steels has the British Empire continued to supply her former proportion of the world's demands. Beaten in competition for the non-phosphoric hæmatite supplies, only available from overseas, Germany perfected the basic method of steel refining, and has certainly made the best of the mineral supplies she had at hand. America also has recognised that it is cheaper to work up ores which are abundant and occur in large masses in the neighbourhood of existing transport routes, and most of her recent steel works extensions have adopted the basic open-hearth process of steel-making. It has paid both Germany and America to adopt the basic process to provide a bulk supply of steel, and it should be equally

profitable for this country to develop a part of its steel-making practice along similar lines, and from home Jurassic ores to produce at least sufficient metal to take the place of the two or more million tons of semi-manufactured metal which until lately was imported from abroad. Probably in peace-time scarcely more than one-fifth of the total output of British pig-iron is applied to purposes which suitably refined basic iron could not serve. "Does it not, therefore, seem that when labour again becomes available for the mining or quarrying of home ores, and for handling the relatively greater bulk as it passes through the furnaces, it will be sound policy here to adopt the basic process on such a scale that, even with expanding trade, it will become unnecessary to purchase from

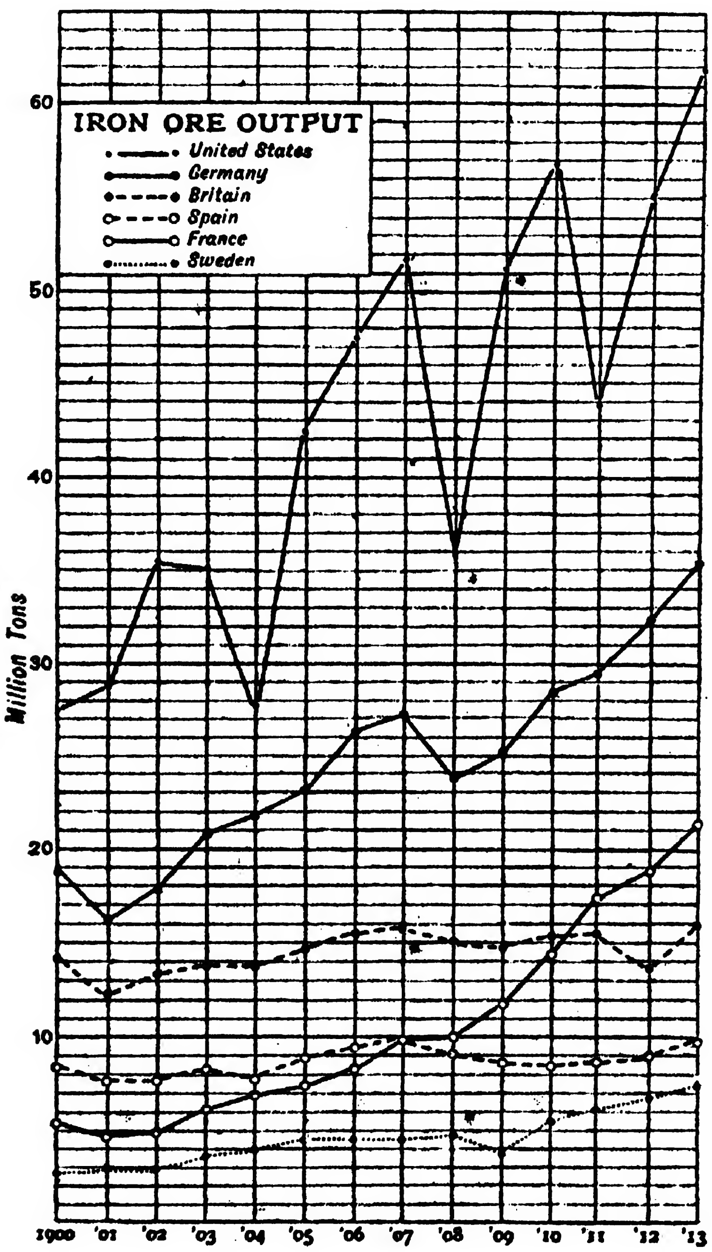

FIG. 3.—Curve of iron-ore output of the United States and Europe.

abroad so large a quantity of ore, for the carriage of which so great a proportion of our mercantile shipping tonnage has in the past been employed?"

Because of the short sea passage, the blast-furnaces near the western coalfields are likely to continue to bring ore from Spanish or Mediterranean ports, and to manufacture hæmatite pig-iron therefrom. To the Cleveland and East Midland districts the orefields of western France and Scandinavia are more convenient, and there are immense possibilities for the extension of the basic iron industry for the smelting of home Jurassic ores. This latter development has already well begun, and in Yorkshire, Lincolnshire, Derbyshire, and Nottinghamshire is proceeding rapidly.

With five thousand million tons of ore ready for quarrying or mining within fifty miles of a region which holds at least fifty thousand million tons of the very best non-anthracitic coal, there is no valid reason for the iron and steel industries of eastern England to look forward except with confidence to the time when the price of overseas hæmatite becomes prohibitive."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The professor of anatomy has, with the consent of the Vice-Chancellor, reappointed Dr. W. L. H. Duckworth, of Jesus College, to be senior demonstrator of anatomy for five years.

A SILVER medal, which will be known as the Adami medal, in honour of Prof. J. G. Adami, F.R.S., is to be awarded annually in the department of pathology in Queen's University, Belfast. The founder of the medal is Mr. J. H. Stirling, Belfast.

IN connection with the Students' Section of the Institution of Electrical Engineers an address will be delivered to-morrow, November 23, at 7 o'clock, at the City and Guilds (Engineering) College, South Kensington, by Sir Oliver Lodge, on "Astronomical Application of the Electrical Theory of Matter."

THE Parliamentary correspondent of the *Times* states that the chances of the Education Bill passing into law this session have been materially improved. Mr. Fisher has in the last few days been in personal conference with important bodies representing local education authorities with reference to the administrative clauses of the Bill; it is understood that their support may be counted on for its second reading.

THE Maypole Dairy Company has given 1000*l.* to the governors of the Southall County School to establish a leaving scholarship in connection with the school, tenable at the Royal College of Science, London, and to be known as the "Maypole Science Scholarship." The headmaster of the school, Mr. S. Pollitt, recently appealed to local manufacturers for financial aid to establish such science scholarships, and the example of the Maypole Company, whose works are at Southall, will, it is hoped, be followed by other industrial enterprises in the district, so that the school may be able to take its part in meeting the need of the immediate future for highly trained technical chemists and other experts in science.

WE learn from *Science* that the Board of Regents of the University of Minnesota has ratified by a unanimous vote the permanent agreement making the Mayo Foundation at Rochester the absolute property of the University, to be used perpetually for higher medical education and research. Securities totalling 330,000*l.*, representing the fortunes of Drs. William J. and Charles Mayo, were turned over to the University. Expenses of the foundation will be paid by the Drs. Mayo until a fund of 400,000*l.* has accumulated. Thereafter the income from the fund will maintain it. The foundation has been affiliated with the University for two years, which was agreed upon as a trial period. Under the final agreement the headquarters of the foundation can be moved from Rochester to another point in the State after twenty-eight years.

THE report of the president of the University College, Cork, for the year 1916–17 has been received. The number of students attending the college during that year was 486, as against 422 during 1915–16, and

only three of the 486 were not studying for the degrees of the National University, of which the Cork University College is one of the constituent colleges. The report records that the city of Cork has made a grant of 150*l.* per annum to the college for the purpose of promoting the higher education of the working men of the city. Additions have been made to the physiological and pathological departments of the college to supply in some measure the accommodation for the large number of students now entering the medical faculty. Further additions are urgently necessary as soon as funds permit of their being carried out. A comprehensive list of books and papers published by members of the college staff during the session is printed at the end of the report.

A COPY of Section X., Higher Education, of the Handbook of the Education Committee of the County Council of the West Riding of Yorkshire has been received. It gives full particulars regarding the scholarships and exhibitions offered by the committee for competition in 1918. The needs of every class of deserving student appear to be catered for. We notice among these numerous aids to the prosecution of higher education the county major scholarships, of the estimated value of 60*l.* to 65*l.* per annum, to be held at universities, university colleges, or other approved institutions; the county free studentships, covering tuition fees at the University of Leeds or the University of Sheffield; the county technological scholarships, value 60*l.* per annum, tenable for day courses or for combined day and evening courses at institutions where higher technical work is carried out; and county coal-mining exhibitions, covering tuition fees for full courses in coal-mining, or in electricity applied to mining, at the University of Leeds or at the University of Sheffield. There are also scholarships for qualified women desirous of specialising in midwifery and nursing, dairy work, horticulture, and other activities. Section IX. of the same part of the handbook will be published in its revised form next January; meanwhile the committee has issued a circular summarising the particulars respecting scholarships and grants available for persons intending in 1918 to adopt the teaching profession.

AMONG other papers included in the June issue of the *South African Journal of Science* is one by the Rev. J. R. L. Kingon on native education in the Transkei. Mr. Kingon refers to the national importance of educating the native, and urges that the plain fact of the matter is that the natives are determined to have education, and will resort to private schools if they cannot get encouragement from the authorities. More than sixty years of native education have produced a rich harvest and fully vindicated the efforts of pioneer workers in this field. A new situation has arisen in South Africa, the article points out, since the consummation of the Union. The responsibilities and dangers of the white men are greater, because of the millions of black men who are now subject to one central Government. Hitherto in the Orange Free State, the Transvaal, and Natal little has been done to educate the native. Again, owing to a defective system, education in the Transkei, which is taken as a typical example, is almost wholly literary in character, though agricultural education is receiving attention apart from the schools. But for the future, Mr. Kingon says, agricultural education must be given a large place in the schools; industrial education, at present a scandal, must be developed, and facilities must be provided for commercial education. From his experience in Transkei, Mr. Kingon insists that the introduction of a liberal and far-seeing policy of native education throughout the Union of South Africa would secure the future progress and stability of the Union.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 15.—Sir J. J. Thomson, president, in the chair.—E. E. T. **Hinue**: A new gyroscopic phenomenon.—A. P. **Laurie** and C. **Ranken**: Investigation into the imbibition exhibited by some shellac derivatives. The paper deals with experiments made on the substances obtained by boiling shellac with carbonate of soda or borax. These solid substances, very similar in consistency to gutta-percha, are found to expand rapidly when placed in water. The control of the expansion by the addition of soluble salts is not the same as in the case of gelatine, since, at any rate in a large number of cases, it does not seem to depend upon the nature of the salt, but simply upon the strength of the solution, the amount of the expansion increasing with the diminution of the strength of the solution. If the expansion is allowed to become complete in cold water, it is not possible to contract the mass again, but in the case of the expansion in a salt solution it is possible to get the mass to contract again by putting it into a stronger solution. Strong salt solutions are also found to precipitate the soluble portion of the shellac borax compound.—G. I. **Taylor**: Phenomena connected with turbulence in the lower atmosphere. In a previous paper by the author it was shown theoretically that a connection should exist between the rate at which heat is conveyed into the atmosphere by means of eddies, and the amount of retardation of the velocity of the lower layers of the atmosphere behind the gradient velocity due to the friction of the ground. In the present paper the amount of the turbulence over Paris is calculated from temperature observations taken on the Eiffel Tower. It is shown that the amount is the same as that calculated from observations of the change in direction of the wind between the bottom and top of the Eiffel Tower due to the friction of the ground. The daily variation in wind velocity which depends on the daily variation in turbulence is next discussed, and it is shown that the chief characteristics of the observed phenomena of daily variation are explained, both qualitatively and, so far as is possible, quantitatively by the author's equations.—E. G. **Bilham**: The relation between barometric pressure and the water-level in a well at Kew Observatory. The water-level shows a well-marked response to changes of barometric pressure at all times of the year. Under similar conditions a given increase of pressure, δp, will depress the water-level in the well by an amount δu, which is proportional to δp. The value of $\delta u/\delta p$ varies with the mean level of the water, but is always negative. The validity of the equation $\delta u = a.\delta p$ was established between limits given by $dp/dt > 0{\cdot}5$ mb./hr., and the value of a was determined in the case of three groups of months representing high, intermediate, and low levels. The sensitiveness of the water-level to pressure was found to increase rapidly with the height of the water, the value of a for a height of 360 cm. above M.S.L. being four times as great as for a height of 200 cm. The change of sensitiveness appears to be entirely due to the change in the condition of the soil. The average value of a is $1{\cdot}1$ mm./mb. There appears to be no lag in the response of the well to changes of pressure, and under favourable conditions the most rapid fluctuations of pressure are shown on the water-level trace.

Zoological Society, November 6.—Dr. A. Smith Woodward, vice-president, in the chair.—Lieut. F. F. **Laidlaw**: Some additions to the known dragonfly fauna of Borneo, with an account of new species of the genus Cœliccia.—Dr. G. A. **Boulenger**: The use of the names Plesiosauria and Sauropterygia.—Dr. J. C. **Mottram**: Some observations upon concealment by the apparent disruption of surface in a plane at right angles to the surface.

PARIS.

Academy of Sciences, November 5.—M. Camille Jordan in the chair.—H. **Douvillé**: The lower Eocene of Aquitaine and its fauna of Nummulites.—E. L. **Bouvier**: The classification of the Eupotamonea, fresh-water crabs of the family of Potamonidæ.—G. **Lemoine**: Free agricultural education. An account of the institutions giving free agricultural teaching in France, most of which are due to private initiative.—W. de **Tannenberg**: A functional equation and spherical unicursal curves.—E. **Camichel**, D. **Eydoux**, and M. **Gariel**: The strokes of an hydraulic ram; calculation of the pressures at any point in the pipe.—A. **Véronnet**: The absorption of water on the moon and planets. If the constitution of the moon is analogous with that of the earth, it is both possible and probable that the rocks of the moon's crust have absorbed all the water by slow diffusion.—P. **Mercanton**: The magnetic state of the Greenland basalts. Under certain conditions, the magnetometric examination of a specimen of lava containing magnetite, the geographical orientation of the specimen having been carefully determined, may indicate the direction of the terrestrial field at the time of cooling of the lava. But the cases in which the theoretical conditions are perfectly fulfilled are rare, and much discrimination is required. Some basalts from Disco (West Greenland), like certain diabases from Isfjord, in Spitsbergen, possess a magnetisation in the sense opposed to the magnetic field existing to-day.—P. **Mahler**: The amount of nitrogen in oxidised coals. Samples of Decazeville coal, from the Combes outcrop, show varying states of oxidation, the calorific values ranging between 8000 and 5200 calories. Analyses of eight specimens are given; the nitrogen content is not much altered by the oxidation.—E. **Maury**: The present conditions and remote origin of the Triassic lignites of the Maritime Alps.—J. **Deprat**: The presence of the Permian at Hongay, and the structure of the edge of the Rhætian of the Tonkin coast in the bays of Along and Fai-tsi-long.—M. **Mirande**: The metachromatine and the chondriome of Chara.—L. **Roule**: The habitat of the tunny-fish (*Orcynus thynnus*) and its coast displacements in the western French Mediterranean.—F. **Mesnil** and M. **Caullery**: A new type of evolutive dimorphism in a polychetal Annelid, *Spio martinensis*.—M. **Marage**: The form of intralaryngeal vibrating air.—J. **Wolff** and B. **Geslin**: The diastatic degradation of inulin in chicory root.

BOOKS RECEIVED.

Organic Evolution. By Prof. R. S. Lull. Pp. xviii+729. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 3 dollars.

Volcanic Studies in Many Lands, being Reproductions of Photographs taken by the Author, Dr. Tempest Anderson, the Text by Prof. T. G. Bonney. Second series. Pp. xv+88. (London: J. Murray.) 15s. net.

On the Eves of the World. By R. Farrer. In two vols. Vol. i., pp. xii+311+illustrations and map. Vol. ii., pp. viii+328+illustrations and map. (London: E. Arnold.) 30s. net.

The Conduction of the Nervous Impulse. By Dr. K. Lucas. Revised by E. D. Adrian. Pp. xi+102. (London: Longmans and Co.) 5s. net.

Lloyd's Diagram for Calculations. By H. G. Lloyd. (London: E. and F. N. Spon, Ltd.) 2s. 6d.

The Yearbook of the Universities of the Empire, 1916 and 1917. Pp. xiii+412. (London: H. Jenkins, Ltd.) 7s. 6d. net.

Origenes y Tendencias de la Eugenia Moderna. By J. Bonilla. Pp. 96. (Liverpool: *Daily Post*.) 3s. 6d. net.

Cotton and other Vegetable Fibres: Their Production and Utilisation. By Dr. E. Goulding. Pp. x+231. (London: J. Murray.) 6s. net.

The Anatomy of Woody Plants. By E. C. Jeffrey. Pp. x+478. (Chicago: University of Chicago Press; London: Cambridge University Press.) 4 dollars net.

The Cambridge University Calendar for the Year 1917–18. Pp. xxvi+1065. (Cambridge: At the University Press.) 8s. net.

Originality: A Popular Study of the Creative Mind. By T. Sharpol. Pp. xvi+304. (London: T. Werner Laurie, Ltd.) 15s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 22.

ROYAL SOCIETY, at 4.—Special General Meeting to receive the Annual Report of the Council.—At 4.30.—Bactericidal Properties conferred on the Blood by Intravenous Injections of Diamino-acridine-sulphate: C. H. Browning and R. Sulbransen.—The Pelmatoporinæ, an Essay on the Evolution of a Group of Cretaceous Polyzoa: W. D. Lang.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Gas-firing Boilers: T. M. Hunter.

FRIDAY, NOVEMBER 23.

PHYSICAL SOCIETY, at 5.—Some Problems of Stability of Atoms and Molecules: Prof. J. W. Nicholson.—Uses of Certain Methods of Classification in Optics: T. H. Blakesley.

MONDAY, NOVEMBER 26.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography of the Italian Front: Dr. Filippo De Filippi.

ROYAL SOCIETY OF ARTS, at 4.30.—Land Settlement within the Empire: Sir John McCall.

WEDNESDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 4.30.—Aerial Transport after the War: G. Holt Thomas.

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THURSDAY, NOVEMBER 29, 1917.

ORGANISM AND ENVIRONMENT.

Organism and Environment as illustrated by the Physiology of Breathing. By Dr. J. S. Haldane. Pp. xi+138. (New Haven: Yale University Press; London: Oxford University Press, 1917.) Price 5s. 6d. net.

DR. HALDANE'S book is a record of four public lectures delivered by him under the Silliman Trust at Yale University in 1916. In the short compass of little more than a hundred pages the author gives an admirable account of the physiology of breathing, based mainly on the researches of himself and his pupils, which have played so great a part in moulding our present ideas on the subject.

The special value of the book to students lies in the fact that the function of respiration is treated simply as one aspect of the activities of the organism as a whole, as a chapter in the unending series of adaptations, internal and external, which make up the life of an individual. There is a real danger that, in the detailed analytical study of isolated phenomena and functions which the student meets with in successive chapters of any text-book of physiology, he may lose sight of the essential unity of all the phenomena presented by a living organism.

The first lecture is devoted to the regulation of respiration and the part played therein by chemical and nervous factors. The second treats of the readjustments of regulation in acclimatisation and disease. After a description of the method in which the hydrogen-ion concentration of the blood is regulated and the effects on the organism of alterations in oxygen-tension, an account is given of the Pike's Peak experiments. It will be remembered that these experiments led to the conclusion that under such conditions of stress as are met with at high altitudes, where there is a chronic deficiency of oxygen, the taking up of this gas by the blood is enhanced by the activity of the epithelium of the lung alveoli, which transfers the gas to the blood at a higher tension than it possesses in the alveolar air. On these experiments many physiologists are inclined to reserve judgment until they have been confirmed and controlled by the use of different methods, especially in view of the fact that earlier experiments, which seemed to show the same active intervention of the alveolar epithelium at normal oxygen-tension, have been disproved by Dr. Haldane himself. It is suggested that these earlier results were obtained when the experimenters were in a condition of chronic CO poisoning, so that their alveolar epithelium had undergone the same acclimatisation as would be evoked by a stay of some duration at high altitudes.

The third lecture deals with the regulation of the environment, internal and external. It is pointed out that "the gross regulation of the circulation is of such a nature as to keep the venous gas-pressures nearly steady, while regulation of breathing keeps the arterial gas-pressures nearly steady." Emphasis is laid on the fact that, in the regulation of the blood-flow, as of the respiration, the determining factor is the metabolic activity of the body as a whole.

In the fourth lecture, which is entitled "Organic Regulation as the Essence of Life: Inadequacy of Mechanistic and Vitalistic Conceptions," the results of the preceding lectures are used as a text from which to expound the author's views as to the methods and aims of physiology. He seems herein to erect dummies, labelled "vitalist" and "mechanist" respectively, for the pleasure later of knocking them down. The reader would gather from this chapter that physiologists were divided into two camps, mechanistic and vitalistic. Is this any more true than the statement, often made by the layman, that the medical world is divided into allopaths and homœopaths? Is there fundamentally any difference in the point of view of physiologists at the present day? All pursue similar methods—the only methods which are open to them—the careful observation of the phenomena of living animals and the average sequence of these phenomena. It is true that one finds among physiologists, as among all other classes of scientific men, the tendency to over-simplify, to fit a new experience into a series which is already familiar, while neglecting details which cannot be so fitted in—an adjustment of facts to curves rather than of curves to facts. But the opposite danger is equally found. Workers, impressed by the seeming impenetrability of the unknown just in front of them, may give up too soon and yield to the temptation of relegating to the arcana of cell-activity processes which further research would have shown to fall within a known category. This faint-hearted attitude might be encouraged by a sentence such as the following: "Those who seek in physiological phenomena for the same kinds of causal explanations as can usually be assigned in connection with inorganic phenomena have no prospect but to remain seeking indefinitely." This prospect is common to all scientific workers, but if the statement implies that no useful results can be obtained in this way, it is not true. We cannot claim to understand or to know fully even the most familiar process in chemistry or physics, and there is no question that further research will considerably modify what are now regarded as fundamental principles—but are really working schemata—in physics and chemistry. The tendency of science is to make its formulæ—its short-hand of phenomenal sequence—more and more wide-embracing. It is a dangerous thing, and savouring of dogma, to set bounds to this development and to assume that the phenomena presented by living beings, as well as those observed in so-called inanimate objects, may not in the future be brought into some one great sequence or natural law.

The fact of consciousness will always remain to remind each of us that all these laws are but

mental shorthand, invented to increase man's control of his environment and his power to survive in the struggle for existence. We can never pretend that they represent ultimate reality, if such a thing is indeed thinkable. Or does Dr. Haldane believe that there is some great formula which will embrace the worlds of soul and body, and will replace, because including, the concepts which we employ in dealing with the objective world? If this were possible, we should indeed be as gods, and there would seem to remain little place for the last few pages of these lectures, in which the author, in accordance with the wishes of the founders, refers to "the presence of God in the natural and moral world." It is the teaching of biology, as of every religion or State code of ethics, that "we are not mere individuals, but one with a higher reality." No system of education is complete which does not inculcate this as its fundamental doctrine, but it is not given to everyone to make the further inferences drawn by the author of these lectures. E. H. S.

THE PERENNIAL PROBLEM OF DYES.

Artificial Dye-stuffs: Their Nature, Manufacture, and Uses. By A. J. Ramsay and H. Claude Weston. Pp. ix+212. (London: George Routledge and Sons, Ltd., 1917.) Price 3*s*. 6*d*. net.

AFTER a concise historical introduction, the authors deal with the distillation of coal and the manufacture of direct coal-tar products. In referring to the very small yield from coal of the principal colour-producing hydrocarbons, the possibility of a new source of these products from petroleum is mentioned. A more general conversion of coal into coke before consuming it as fuel would also lead to a further supply of these valuable hydrocarbons.

It is an unfortunate feature of this text-book that the chemical foundations are unsound. This detracts considerably from its utility as an introductory manual to the study of the artificial dye industry. The only other *raison d'être* for the work, namely, that of an exhaustive treatise, is disclaimed by the authors.

The azo-group present in the largest class of artificial dyes is defined incorrectly as "a radical consisting of two atoms of nitrogen which can be substituted in a suitable substance for one atom of hydrogen." The consequences of this fundamental error are to be seen in the absurd formula for Bismarck brown on p. 63. The chemical mechanism of the diazo-reaction defined long ago with precision by Griess, the discoverer of the process, is apparently not understood clearly by the authors, who on p. 41 give the formula $C_6H_5.N_2HCl$ to diazobenzene hydrochloride (*sic*). This confusion is continued on p. 42 in the formation of aminoazobenzene. It is only fair to direct attention to these elementary details, because the authors attach importance to them, stating (p. 44) that "if the reader has thoroughly mastered the explanation in the foregoing pages . . . he will be in a position to understand the nature and manufacture of almost any of the series of azo-dyes."

Pyrogallol or "*v*-trihydroxybenzene" is furnished with the structural formula of its isomeride, phloroglucinol. Salicylic acid is stated to be manufactured from anthranilic acid, but this can scarcely be the prevailing method. Confusion rules in regard to "1 : 8 : 4-dioxynaphthalenesulphonic acid," this dihydroxy-derivative of naphthalene being endowed with two atoms of univalent oxygen. Direct or "substantive" dyes are said to be formed within the fibres themselves. Phthalic anhydride is formulated as $C_6H_4(CO_2).O$, but the errant carbon atom returns to the molecule at phthalimide. On p. 111 the words "left" and "right" should replace "top" and "bottom" in the description of the quinonoid hexagon. If this formulation is accepted, it is incorrect to add that the hexagon is linked to chlorine as well as to an amino-group. The formula for *m*-tolylenediamine on p. 133 is incompatible with the constitutions assigned to tolylene red and blue on the same page.

These and other similar chemical errors mar the utility of a text-book which is much more satisfactory in its outline of manufacturing processes, and contains a series of informing diagrams. G. T. M.

THE NEW REGIONALISM.

Can We Set the World in Order? The Need for a Constructive World-culture. By C. R. Enock. Pp. 198. (London: Grant Richards, Ltd., 1916.) Price 3*s*. 6*d*. net.

THE man of fact and the brooding thinker are rarely united in one to form a great leader. Here we have pre-eminently the man of fact. Few pages of this work but evidence the travelled observer richly harvesting facts with admirable zeal for social reconstruction; we therefore warmly recommend his labours to all who would ameliorate the gross and widespread inequalities of human lot.

The author pleads for a "science of human duty in moulding the earth that it may be the home of a high and universal civilisation" (p. 34): truly a lofty ideal. He advocates a co-operative world-survey of economic possibilities, and thereafter the development of a world-order, based upon federated units of industry so organised that every region shall become, so far as geographically possible, an "organism" (p. 41), "self-supplying and self-contained," within "its natural radius of action" (p. 40). A sense of "place-possibility," or "the culture of the locality," should teach us "to regard a place as an organism, capable of being brought to a flourishing and permanent state of life, just as we bring an individual to such a state" (p. 56). To this end, useful "Town-planning" should grow into "Industry-planning" Acts, together culminating in "country-planning," or "the economic consideration and control not only of urban but of rural areas, for . . . in the

exercise of a science of corporate, or constructive, human geography, manufacture and agriculture, the workshop and the land must become reciprocal and complementary" (chap. iv.). This policy would involve national co-operation, and ultimately international also (chap. ix.).

Amongst the far-reaching consequences, Mr. Enock anticipates: scientific limitation to the growth of towns and the healthy "pruning and reconstruction" (chap. v.) of over-grown population-centres, with their nests of hunger, squalor, and disease; world-wide decentralisation of industry (chap. vi.); and the rehabilitation of native "arts and crafts" (chap. vii.), now rapidly disappearing or pathetically deteriorating under cut-throat competition of the unregulated growth of machine industry.

So much for the strength of a notable volume that courts a second study, though revealing thereby its weaknesses also.

In good faith we accept Mr. Enock's belief in the originality of his diagnosis and proposals. But his historical chapter (xv.: "The Failures of Utopias") with the book as a whole is, to one sympathetic reader at least, conclusive evidence of the insufficiency of his grasp of the work of predecessors and contemporaries; of failure or incapacity to think out fundamental principles systematically; and of inadequate assessment of human passions and financial factors.

Perhaps Mr. Enock is himself not wholly unaware of these serious defects: he mentions, frankly and often, serious difficulties, but only to pass them by on the ground—ill-chosen, we submit to him—that they are not substantially relevant.

In the spirit of his own "corporate" science we therefore venture this advice: Let the author conjoin with himself, or at least seek the frank criticism of one thinker expert in politico-economic history, and another versed in finance. And let him add a good index.

Benchara Branford.

OUR BOOKSHELF.

Le Paludisme Macédonien. Par P. Armand-Delille, P. Abrami, G. Paisseau, et Henri Lemaire. (Collection Horizon Précis de Médecine et de Chirurgie de Guerre.) Pp. viii+109. (Paris: Masson et Cie, 1917.) Price 4 francs.

This is a very lucid and terse description of the symptoms and treatment of malaria, based largely on experience of that malady among soldiers infected in Macedonia. The subject is treated after the method of many recent French writers, in that a sharp distinction is drawn between the symptoms of primary and secondary malaria. We doubt, however, the reality of the distinction, and if it exists, it practically is not of great import, for the fundamental treatment is always the same, viz. quinine. In one respect we consider the authors' mode of dealing with the subject is unsatisfactory: they discuss malaria as a whole. We believe, on the contrary, that the proper method is to determine first what species of parasite is present in the blood, and then to associate clinical observations with that species alone. That this is the sounder method is exemplified by the occurrence of comatose symptoms almost exclusively with the malignant tertian parasites, and other instances might be given.

In the section dealing with treatment, sufficient emphasis is not laid on the very important distinction between a temporary and a permanent cure. Any of the methods given in this book would suffice to secure the former, but none of them will, in the majority of cases, affect a real cure, *i.e.* the elimination of parasites from the system—*e.g.* in simple tertian malaria—at least in a reasonable time, say two to three months; for in longer periods generally *vis medicatrix naturae* alone will produce the desired result. That, however, a cure can, in the majority of cases, be effected by improved methods of quinine treatment, we believe experience of malaria in this war has shown. The student of malaria can with advantage study this book.

The Quest for Truth (*Swarthmore Lecture*). By Silvanus P. Thompson. Pp. 128. (London: Headley Bros., Ltd., 1917.) Price 1*s.*

"The Quest for Truth" is a lecture given to the Society of Friends, of which the late Prof. Silvanus Thompson was a member; but it will be helpful to all who, like genuine students of science, put truth in the first place. Of that community any distinctive opinions are mentioned only in the latter part, and here an orthodox Churchman, though he could not admit that the Council of Nicæa decided "person" and "substance" to be the same, for the terms there used were the more adequate "hypostasis" and "ousia," and may think Prof. Thompson failed to apprehend the full significance of the "Virgin Birth," will welcome the catholicity of his creed. The earlier and larger part of the lecture deals with the methods and spirit demanded in all who undertake so toilsome a pilgrimage. Here is made clear the distinction between categorical and analogical truth, the moral obligation of truth-speaking, the evils consequent on neglecting it, and those which arise from the misuse or misunderstanding of words, from over-respect for authority, from carelessness and impatience in research, and other weaknesses of human nature—evils so patent at the present day in politics, in religion, sometimes even in science.

The quest for truth is never popular, for it is not that of the crowd, and the discovery of it is "not for him who is careless of truth in speech or deed, or in habit of mind. Neither is it for him whose thinking apparatus is in a state of confusion." Extremists in orthodoxy will doubtless place Prof. Thompson's book on their Index, and materialists will class him with the credulous; but others, and they not few, will welcome this little book as the legacy of an eminent student of science and a truly religious man.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

"Fascination" of Birds by a Snake.

I HAVE just received the following record of an observation made on September 19 by Capt. G. D. H. Carpenter, at Itigi, about 150 miles east of Tabora, on the Central Railway of late German East Africa. Capt. Carpenter's account recalls the behaviour of small birds to a cuckoo or an owl, and suggests that they were "mobbing" an enemy rather than fascinated by it. The observation may supply the clue to the interpretation of all cases of supposed "fascination" by snakes. EDWARD B. POULTON.

Oxford, November 24.

"Yesterday afternoon I witnessed what I have always found difficult to believe, namely, the strange 'fascination' of birds by a snake. I came upon a party of very pretty little finches hopping about among thick dead twigs of a fallen branch on the ground. I came on them quite suddenly from round another bush, and stopped dead when I saw them to watch them. Though I was within a couple of yards they did not fly away, but continued to hop about, all gradually coming closer and uttering faint chirps. I thought I had never seen such tame birds, and admired their beauty. While looking at the *birds* I quite missed an Elapine snake, which suddenly attracted my attention by striking at a hen finch just in front of me! It fluttered back a foot or two, and the snake got a mouthful of feathers among its teeth, which seemed to incommode it, for it went down among the thin grass at the foot of the clump of twigs, where I could still see it. The birds none of them made any attempt to get away, but actually several of them, including the one already struck at, hopped further down to get another look at the snake! The latter bird did show some signs of agitation, as every now and then she spread out her tail fanwise and kept on chirping, but still went nearer. However, after a bit the birds flew away one by one, without any excitement, and I crept up and found the snake had gone. I wished I had seen the snake before it struck, to see which way its head was pointing. Of course, I do not believe in the mesmeric theory, but it was *not* a question of a snake pursuing a victim which was too frightened to run away"

Pyrometers and Pyrometry.

I DESIRE to compliment you on the summary in NATURE of November 15 of the recent meeting of the Faraday Society on pyrometers and pyrometry; it is quite the best of the various summaries and accounts published in the technical Press.

With reference to the question of automatic control, I think it is only fair to the English pyrometer manufacturers to say that methods of the kind described by Mr. R. P. Brown, of Philadelphia, have been employed previously, using instruments of English manufacture. In my judgment the present position is rather that the instrument manufacturer is waiting on the furnace user. Heating processes, in the majority of cases, are not so far developed towards standardisation as to make any very extensive call for this automatic control. In the majority of cases an ordinary recording pyrometer, producing its record under the observation of the man controlling the furnace, achieves all that industries at present require; the shape and slope of the record line give the furnaceman a power of anticipating the temperature change which will take place in his furnace and of altering the firing accordingly.

CHAS. E. FOSTER.

Letchworth, Herts, November 19.

IRON-ORE DEPOSITS IN RELATION TO THE WAR.

THE *Fortnightly Review* for November contains an important article headed "Coal and Iron in War: The Importance of Alsace and Lorraine," which sets forth very clearly an aspect of the European war that has received far too little attention in this country, though its importance has been for some time fully recognised on the Continent. The article consists essentially of a statement as to one of the main causes of the origin of the war, and of a deduction showing the proper nature of the penalty that should be exacted from the originators. The contributory cause discussed is the intense desire of the German plutocratic group, the great German ironmasters, of which such firms as Krupp and the Deutscher Kaiser are representative, to obtain a monopoly of that vast deposit of iron ore which covers so large an area of Central Europe, and is known as "Minette." The writer in the *Fortnightly Review* rests his presentation of the case very largely upon the strong evidence contained in a memorandum submitted on May 20, 1915, by the six leading industrial and agricultural societies of Germany to the Chancellor, in which their requirements and demands in regard to the terms of peace are set forth. The most important of these in the present connection is the demand that Germany should retain possession of the French coast region as far as the Somme, because "by the acquisition of the line of the Meuse and of the French coast the iron-producing district of Briey, as well as the coal-fields of the north and of the Pas de Calais, would be acquired."

The *Fortnightly Review* has done valuable service to the nation in directing attention to this memorandum; if any evidence at all were needed to show that Germany was not forced into this war for self-defence, as Germans are so fond of alleging, but went into it deliberately for the sake of rapine and plunder, this document supplies it to the full, seeing that it specifies in detail the booty of which Germany was deliberately preparing to rob her neighbour, an act of robbery which would certainly have been consummated but for British intervention. The facts as to the importance of the Minette ores are well enough shown in the article referred to, but a full knowledge of all the circumstances makes the case even stronger. In the year 1911 a full account of the Minette iron-ore deposits appeared in the well-known German paper *Stahl und Eisen*, the figures given in which are most illuminating. It is stated that the area within which these ores are workable covers 70,000 to 80,000 hectares, of which French Lorraine possesses 40,000 to 50,000, German Lorraine 27,000 to 28,000, Luxemburg 2500, and Belgium only a

few hundred hectares, and estimates of the quantities of ore available are given as follows:—

French Lorraine	3100 million tons
German Lorraine	1841 " "
Luxemburg	250 " "
Total	5191 million tons

It may be added that the Briey basin alone, by far the most important of the French ore-fields, is estimated here to contain 2000 million tons, or more than the whole of the German deposits, and it is this particular basin that, as shown above, is the main objective of German rapacity.

There is, however, more in the question than appears even from the above figures of quantity of Minette; it is also a question of quality. The German writer of the article referred to admits that the Briey ore is at least 4 per cent. richer in iron than the Minette on the German side of the frontier, whilst other authorities put the difference at 6 per cent., averaging the German ore at 29 per cent. and the Briey ore at 35 per cent. of metallic iron. No ironmaster will need to be told that the advantage in favour of the French ore is of immense importance, and the German writer shows very clearly how great is the fear of French competition. "From the point of view of the domestic Minette-mining industry," he writes, "it would be a matter for sincere regret if in the German customs area [*i.e.* Germany proper and Luxemburg] the import of French ore were to increase more and more, thus displacing Minette of German origin."

The fear of French competition grew year by year, and in 1913 the same paper, *Stahl und Eisen*, pointed out that owing to the increasing production of the richer French ore, large portions of the Minette of German Lorraine would necessarily have to remain unworked. The anxiety of the plutocratic German ironmasters was becoming evident; they were gradually, by their methods of "peaceful penetration," getting a considerable financial control over the Briey ore-field, but these methods were too slow and too costly for their measureless greed, and they did not hesitate to sacrifice millions of human lives in order to effect their policy of rapine. So recently as October last a Pan-Germanist Leipzig paper was maintaining that Germany must not only keep Alsace-Lorraine, but must also annex the ore-fields of Longwy. It says:—

> Before the war France produced annually twenty-two million tons of ore, of which nine-tenths came from the Longwy basin, and Germany extracted annually from Lorraine twenty-one million tons, or, say, three-fourths of its entire output. If therefore Germany keeps the mines of France and of Lorraine, she would have available fifty million tons of iron ore yearly. She would then possess the monopoly of iron ore in Europe, which would furthermore assure continuous work and prosperity to the German working classes.

All this mass of evidence drives home the contention of the writer in the *Fortnightly Review*, and shows clearly how important the German ironmasters consider the ores of the Briey basin to be to them. The present war would have been impossible had not two British inventors, Messrs. Gilchrist and Thomas, shown how to convert phosphoric iron ores into good steel, incidentally also producing at the same time a slag of a high manurial value; having applied this process, which, by the way, was not discovered until after 1870, to the Minette in the portion of Lorraine already annexed, German ironmasters now want to grasp the rest of this valuable iron-ore deposit, the importance of which has been rendered evident through the basic steel process.

H. LOUIS.

SCIENCE, INDUSTRY, AND COMMERCE IN INDIA.

LITTLE more than ten years have come and gone since the suggestion was first made that lack of co-ordination, in the scientific departments of India, had often resulted in needless duplication, in useless departmental jealousies, and in the divorce of what may be called economic research from commerce and industry. Under Lord Curzon's enlightened guidance this *impasse* led to the formation of the Board of Scientific Advice for India. Since 1902 each year has witnessed important advances of a gratifying nature, so that it may be said that the annual reports of the Board, of which that for the year 1915-16 is before us, epitomise certain aspects of the scientific work accomplished in India.

The Government of India had previously tried the experiment of subsidising societies and institutions (both in India and England) with the view of delegating to them its responsibility in the matter of science research. This had the effect, not of encouraging the growth of science, but of degrading local scientific men into specimen collectors. The linking together, therefore, within India itself, of the chief scientific departments gave the strength of unity and the courage of public recognition. But has this very necessary reform been carried to its rational conclusion? The chief officers of the following departments constitute the Board: the Secretary of the Department of Revenue and Agriculture (*ex-officio* President of the Board), the Directors of Observatories, of Zoology, and of Surveys, the Principal of the Veterinary College, the Inspector-General of Forests, the Agricultural Adviser, the Directors of the Geological and Medical Services, the Secretary in the Public Works, and the Directors of the Indian Institute of Science and of the Botanical Survey.

But why is education not more directly and fully represented? Surely the utilisation of the chemical and physical laboratories of the universities, and of the services of the professors in charge of these, are obvious directions of economy and utility. So, again, one is tempted to ask, Why has statistics been overlooked? Still again, Why has the Director-General of Commercial Intelligence no seat on the Board? To the non-official mind the Department of Commerce and Industry should very possibly have a co-equal share with the Department of Revenue and Agriculture (and certainly a

stronger claim than that of the Public Works Department) to participate in the deliberations of the Board. But, leaving the great departments of State on one side, there are other very important interests that might with advantage be directly associated with State science, such as the chambers of commerce, the various associations of special trades and industries, the learned societies, the Industrial Conference, the superintendents of museums, the directors of industries, of engineering works, factories, foundries etc., and the experts in charge of the investigations into silk, cotton, jute, paper, timbers, dyes, tans, leather, tea, coffee, etc., both public and private—these and many others need opportunity, guidance, encouragement, or, it may be, direct help. The Board of Scientific Advice will not fulfil its programme of public service until it has designed a working plan that will link up all branches of industry with both official and private science research.

For some reason, unknown to the public, the old office, first designated that of the Reporter on Produce to the Secretary of State and then resident in London, and afterwards that of the Reporter on Economic Products to the Government of India and resident in India, has been abolished and its duties assumed apparently by the officers of economic branches in botany, zoology, geology, agriculture, and forestry. But this new arrangement, while it gains in official influence, fails in public advantage, since it loses touch very largely with commerce. To the merchant it is immaterial whether a resin, a medicine, or a fibre is of animal, vegetable, or mineral origin. If, therefore, he has to go from one State department to another in search of needed information, he may find his patience exhausted long before he has discovered the object of his quest. With a Reporter on Economic Products (and a commercial museum fully equipped with all products, whether of animal, vegetable, or mineral origin) attention could be focussed on the products themselves, not on departmental limitations. It is to be feared that this illustration exemplifies the danger that underlies much of the Indian departmental research, even when controlled by a central organisation such as that of the Board of Scientific Advice. The cart is put before the horse. The machinery is cumbrous, and research made to supersede material, both in interest and value. Is the Board working so as finally to meet this position? Has it not even now been made evident that a bureau or exchange (call it by whatever name you please) may have to be reorganised so as to act as the Reporter on Economic Products did, as the intermediary between science and commerce in all departments?

It is scarcely necessary to classify research; there are obvious diversities according to the object aimed at—commercial, medical, veterinary, etc. Hence it follows that the field of operations covered by the Board of Scientific Advice is far wider than that of economics pure and simple, but it may perhaps be useful to concentrate attention on one issue, since it is more or less illustrative of the whole of the Board's activities. Is there any particular advantage in the report becoming a channel of publication for jottings, interesting no doubt, but often gleaned from papers and periodicals published throughout the world, instead of being confined to a fairly detailed Imperial review of the actual operations controlled by the Board? In place of jottings one is surely justified in looking for special chapters devoted, far more than they are, to narrating commercial and industrial requirements and setting forth the progress made with such previously agreed-upon subjects of investigation.

So, again, too much importance would appear to be attached to the compilation of lists of scientific papers, books, and periodicals. The report is thereby converted into a sort of advance proof of the catalogue of the Royal Society. Doubtless these classified lists, especially of extra-Indian publications, are useful to the various departments concerned, but they do not appear of sufficient importance to constitute so very distinct a feature of the annual report of the Board of Scientific Advice for India. Further enumerations of the names to new species of plants or animals, discovered during the year, scarcely amount to manifestations of scientific research. Systematic studies in the aggregate stand on quite a different platform from the mere mention of a few individual species, in themselves of no importance. Trivialities of this nature give the impression that the fundamental principles of research are being lost sight of, and possibly very largely so, through the reason set forth, namely, of science being divorced from commerce and industry.

PITFALLS OF METEOROLOGICAL PERIODICITIES.[1]

THERE is a real danger that some meteorologists, resenting the accusation frequently made against them of accumulating masses of data without making any real use of them, may be tempted to apply the processes of mathematical analysis to any and every set of observations, regardless of the considerations which limit the suitability of the method for the particular data proposed for analysis. This may easily be the case when hunting for periodicity. There is a great temptation, especially for anyone accustomed to the regularity of so many cosmic phenomena, such as eclipses, comets, planets, etc., to expect to find such periods recurring in the weather, but the work before us, consisting of the essential portions of a dissertation by Dr. Ryd, fortunately thought worthy by Capt. Ryder, director of the Danish Meteorological Institute, of a wider publication, and so included in the Communications of the Institute and done into intelligible English, should be studied before much time is spent in the search.

Dr. Ryd sets out clearly certain characteristics of meteorological data, wherein they differ essentially from, *e.g.*, astronomical data. One of these

[1] Publikationer fra Det Danske Meteorologiske Institut Meddelelser. No. 3, "On Computation of Meteorological Observations. By V. H. Ryd. (Copenhagen, 1917.)

is the impossibility of eliminating some forms of "systematic" error, which are too likely to be variable to be strictly systematic, such as the difference between the indications of a thermometer, under various conditions of exposure, and the real temperature of the air. Another is an error neither accidental nor systematic, but due to the fact that the data are meteorological; a good example of this is afforded by the mean diurnal variation of air temperature as shown on (*a*) overcast or (*b*) cloudless days.

Dr. Ryd regards harmonic analysis applied to such data as an excellent interpreter, but a very untrustworthy probe. The known periods—the day and the year—are unexceptionable, and the variation from hour to hour in one case, and from day to day, or preferably from "pentad" to "pentad," in the other, are obviously fit subjects for analysis. Dr. Ryd prefers to use both sine and cosine terms instead of the usual transformation, because the determination of mean error is more direct when two constants enter similarly. This is clearly important, as the mean error is a vital consideration. Analysis for testing a real period, such as one of the lunar periods, on the meteorological data is not quite so risky as tentative fishing for an unknown period, in which case at least one coefficient, according to Dr. Ryd, must be five times its probable error before it can be regarded as likely to be real.

The brochure is divided into two sections, the first dealing generally with such routine problems as the computation of the mean error, smoothing and adjustment of observational data, and harmonic analysis, with an additional chapter on secondary minima and maxima in the annual variation of the temperature, in which the author deals with the proverbial "Ice-men" of May 11, 12, and 13, and exposes the weakness of Dove's supposed proof of the reality of this legendary phenomenon. The second part deals fully with "mechanical" adjustment, factors of variation, and suggestions on the choice of adjusting formulæ, of which several are given, and a longer chapter is devoted to the working out of four concrete examples, viz. the hourly inequality of air temperature, Greenwich, 1849 to 1868; and of pressure, Greenwich, 1854 to 1873; the annual inequality of pressure, Batavia, 1876 to 1905; and the annual variation of temperature, Copenhagen, 1875 to 1910, the last being a case of partial data—only three observations at fixed hours of the day, instead of the full set.

Dr. Ryd reminds the reader that when data such as July air temperature for twenty years are entered in rows for days and in columns for years, they cannot be analysed similarly in both directions, inasmuch as the successive days are not independent, while the columns are. He also discusses at some length the "order" to which harmonic analysis, if used for adjustment, should be pushed, with hints for saving labour; but on the whole he prefers the "mechanical" adjustment with a suitable formula in the majority of cases, and thinks this method less liable to introduce new errors into a problem. W. W. B.

NOTES.

SIR ARCHIBALD GEIKIE, O.M., who has long been a correspondant of the Paris Academy of Sciences, has now been elected an associate member of the academy.

THE *Times* announces that the report of the Departmental Committee on salaries of teachers will be issued within the next few weeks. The report of Sir J. J. Thomson's committee on science teaching is also expected at an early date.

THE council of the Royal Meteorological Society has awarded Dr. H. R. Mill the Symons gold medal for 1918 "for distinguished work in connection with meteorological science." The medal will be presented to Dr. Mill at the annual meeting of the society in January next.

AT the meeting of the Chemical Society to be held on December 6, Dr. F. L. Pyman will deliver a lecture entitled "The Relation between Chemical Constitution and Physiological Action."

THE Hon. Sir Charles Parsons, member of council of the Institute of Metals, is to give the eighth annual May lecture before the institute next spring. He will deal with the subject of the formation of diamonds, with the artificial production of which he has been experimenting for more than thirty years.

THE death of Mr. Alexander Adamson is announced in *Engineering* for November 23. Mr. Adamson was born in Glasgow in 1846, and took a prominent part in the evolution of the modern Atlantic liner, and was later identified with the early stages of development of the Barrow works, now the most important naval armament and munition works in the kingdom. He served for some years on the council of the Institution of Naval Architects.

THE death is announced in the *Chemist and Druggist* of November 24 of Prof. Charles Caspari, jun., dean of the Department of Pharmacy in the University of Maryland, and Food and Drug Commissioner of the State of Maryland. Prof. Caspari's "Treatise on Pharmacy" is well known on this side of the Atlantic. In addition, Prof. Caspari was one of the editors of the U.S. Dispensatory and a member of the Revision Committee of the United States Pharmacopœia.

WE regret to note that *Engineering* for November 23 announces the death, from heart failure, of Mr. Peter Denny, a member of the Dumbarton family which has done so much work to establish shipping and marine engineering on a truly scientific basis. In this work Mr. Denny took an effective part, and also fulfilled in a marked degree those varied duties of an employer of labour connected particularly with the social life of the worker. Mr. Denny, who was in his sixty-fifth year, joined the Institution of Naval Architects in 1880.

AT the monthly meeting of the Zoological Society of London, held on November 21, it was stated that during the months of August, September, and October 281 additions had been made to the society's menagerie. Of these, perhaps the most interesting are a brindled gnu, from South Africa, and an anoa, from Celebes. Having regard to the times, one can scarcely be surprised at the announcement of a falling-off in receipts during 1917. From January 1 to October 31 this amounts to 3806*l.* Happily, the number of fellows elected and re-admitted shows an increase of thirteen, as compared with the corresponding period last year.

IN his presidential address to the Royal Statistical Society on November 20 Sir Bernard Mallet referred to the damage which the present war must inflict upon this and other nations. The United Kingdom has lost

by the fall in births more than 500,000 potential lives, while Germany during the same period has lost 2,600,000, and Hungary 1,500,000. At the outbreak of war the population of the Central Empires was about two and a half times as great as that of the United Kingdom, but their losses of births have been apparently ten times as great. The reason for this difference may be that while the poorer classes in this country have never experienced more favourable conditions, the Germans, if all indications are to be believed, have suffered to such an extent as to affect seriously the general health of the population. The infant mortality in Germany has been some 50 per cent. higher than in this country.

THE *Revue Scientifique* announces the death on November 4, at fifty-eight years of age, of Prof. R. Nicklès, professor of geology in the University of Nancy. Early in his career he investigated the geology of the provinces of Alicante and Valencia, in Spain, and in 1891 this was the subject of his doctoral thesis. He also published important memoirs on the Lower Cretaceous ammonites which he had collected in Spain. While professor at Nancy he collaborated with the Geological Survey of France, and devoted special attention to the coalfields buried under Mesozoic strata in Lorraine. By purely scientific work he was able to indicate the most likely spots for successful borings, and the result was the discovery of valuable coal-seams at a depth between 700 and 800 metres. Prof. Nicklès communicated several notes on this subject to the Academy of Sciences from 1905 to 1909, and the value of his researches was acknowledged by the Geological Society of France, which awarded to him the Gosselet prize in 1911.

BY the death early in November of Lieut. Cyril Green on the Palestine front a botanical career of much promise is cut short. Cyril Green was the youngest son of the late Rev. T. Mortimer Green, registrar of University College, Aberystwyth. At this college, where he studied botany under Prof. R. H. Yapp, he graduated in science in 1911, receiving a first class in botany honours. In 1912 he joined the staff of the Department of Botany at University College, London, where he showed marked abilities as a teacher. Green's investigations lay especially in the field of plant ecology, and included a detailed survey of Borth Bog, an area of no little botanical interest. He also worked at the physiological anatomy of water plants. Since the outbreak of the war he had been appointed head of the Department of Botany in the new Welsh National Museum at Cardiff, a position which was to have been held open for him until the conclusion of hostilities. Already before the war Green held a commission in the London University O.T.C., and was transferred to the Royal Sussex Regiment. Severely wounded in action in France in May, 1915, he was, on recovery, attached to an officers' cadet battalion as instructor. In June, 1917, he was sent to Egypt, and fell in action in the recent advance in Palestine. This Egyptian campaign had a special interest for Green, as it brought him in contact with a flora of which he had previously gained some knowledge in botanico-antiquarian studies carried out by him in connection with the Department of Egyptology at University College. The last correspondence received by his colleagues related to this flora. His brother, Capt. H. M. Green, of the Welsh Regiment, has been posted as missing since Suvla Bay.

THE proposed organisation of the clay industries, discussed at a meeting of employers at the Guildhall on November 23, would undoubtedly have a beneficial and far-reaching effect if properly carried out, as seems highly probable. The keynote of the speakers (among whom were Messrs. H. Lewis, J. H. Whitley, and G. J. Wardle) was cordial co-operation between capital and labour, with the ideal of substituting for the proved general inefficiency of individualism a sense of industrial solidarity for national service. Mr. Wardle intimated that the scheme does not propose to pool capital or profits, but rather technical knowledge, the inadequacy and restricted diffusion of which have been a very serious obstacle to British industry. Men of science long ago proclaimed this disadvantage, but their strenuous efforts to bring about an improvement failed almost entirely. Now, under the stress caused by a terrific world-conflict, a flood of new light has been thrown on many matters which used to be subjects for bitter controversy. Standardisation would unquestionably tend to check waste, but, as Mr. Wardle remarked, it must not stand in the way of invention and new processes. It is noteworthy that Mr. Lewis handsomely acknowledged that no grant of public money had been more usefully employed, or was likely to be productive of greater results in the future, than that voted for research purposes. This is certainly no less true of money provided for research in connection with the clay industries than of contributions made towards research in other directions.

PROF. LEONARD HILL has in Monday's *Times*, November 26, an interesting letter on scientific rationing. He points out that as a machine the efficiency of a man is about 25 per cent., three times as much heat being produced as external work done. During complete rest in bed, fasting, the energy spent in the internal work of the body is determined. This averages one Calorie per kilogram of body-weight per hour for all average people—about half the expenditure of the man doing light work. All unproductive people, idlers, old, and invalid, can save a large part of the food they eat by lying in bed warm and at rest. With regard to different classes of workers, the same measure of meat is not suitable for them all, because meat, far more than carbohydrate or fat, stimulates the living cells to live at a vigorous rate. Prof. Hill states that experience shows that the higher class of brain-workers, the organising and driving power of the nation (which must not be lessened), secures its energy most easily out of a diet containing a higher proportion of meat, and that carbohydrate is utilised very well by producers of mechanical work. He says that the Yapp ration, considering the difficulty of securing all the rationed foods, affords scarcely more than half the energy necessary for productive labour. "At current prices flour yields more than 700 Calories for a penny, meat and cheese about 100, margarine 300. To ration bread and flour, then, should be the last measure of emergency; the physiologist cannot conceive rationing these while luxury trades continue and fields are not fully cultivated or ships built to the utmost; while spirits are distilled from foodstuffs for munitions, and great stores of alcohol are left untouched; while the problem of transport of potatoes and swede turnips to the urban populations has not been solved; while shipping is not used to the maximal advantage to maintain the importation of cereals."

Fas est et ab hoste doceri. In an article on "A Central Bureau of Commercial Intelligence" in the November issue of *United Empire*, Major Cuthbert Christy urges us to follow the example of Germany in taking steps to turn to account with the least loss of time and energy the resources of the British Empire. The point which he chiefly insists on is what may be comprehensively described as the indexing of knowledge. The parts of the Empire that he has principally in view in making his present suggestions are those in Africa, especially tropical Africa. "The once 'Dark Continent,'" he says, "is certainly the richest of the

five, though the fact may be known to few, not only in mineral wealth, but also in agricultural possibilities, and must in the near future, when central and trans-African railways are constructed, become a field of vast undertakings, of thriving native industries, and perhaps the world's chief source of raw materials." What he would have in order to hasten the utilisation of these resources is, first, a central institution in London which, according to his ideas, would be merely a fuller development of the Imperial Institute on the lines of the Hamburg Colonial Institute, of which he gives an account, and, secondly, Colonial sub-centres which the chief centre would supply with abstracts of the voluminous information already collected. "It should be obvious that where the information and training are most useful is at the source of the raw material." For this idea also he acknowledges German origin, referring to his own experience at the fine botanical gardens and laboratories at Victoria, in the German Cameroon colony. All this seems well worthy of consideration, but we would add one suggestion, that the information thus collected and distributed should include, so far as possible, estimates of the cost of production of the Colonial commodities, expressed not merely in money, but also in amount of labour employed. Production per head is an even more important rubric than production per acre.

THE inaugural address on "Science and its Functions," delivered by the chairman, Mr. A. A. Campbell Swinton, at the Royal Society of Arts, on November 21, contained an appreciative reference to the work of Sir Henry Trueman Wood, who recently resigned the post of secretary of the society held by him for thirty-eight years. Mr. G. K. Menzies, who has been Sir Henry's assistant for the past nine years, succeeds him as secretary. The chairman then reviewed the progress of science in the past, showing that the most primitive peoples had applied a knowledge of natural laws in an elementary way in fashioning their weapons and implements. Later, in the kingdoms of Babylon, Assyria, and Egypt, and later in Greece, various sciences were studied, and the lecturer mentioned instances of their application to practical problems. Turning to more recent periods, he contrasted the condition of this country in 1754, the year in which the society was formed, with those prevailing to-day. The society was older than many familiar discoveries and inventions. Dealing with the problem of scientific education, Mr. Campbell Swinton pointed out that many of the greatest discoveries and inventions had been made in the past by men with little formal scientific training, and in fields quite outside their ordinary vocations. Thus James Watt was a maker of mathematical instruments, George Stephenson a colliery fireman, Arkwright a barber. Edison began life as a railway porter. Cavendish, Boyle, Sir William Herschel, and other great workers in the field of pure science might be described as gifted amateurs. No rigid distinction could be drawn between pure and applied science. Wireless telegraphy afforded a good instance of purely theoretical work leading to unforeseen vast practical results, and the same would doubtless apply to recent researches in molecular physics. Finally, the pointed out that the acquisition of wealth was not necessarily a disservice to humanity. Inventors and men of science by their discoveries created wealth, and in general received but a small fraction of the riches which their efforts conferred on the community.

IN the November issue of *Man* Mr. Harold Peak describes a figure recently acquired by the Borough of Newbury Museum. It is said to have been discovered at Silchester, and it has all the appearance of being contemporary with the Romano-British town of Calleva. It is of dark bronze, 12 cm. in height, and represents a male deity or Lar, standing erect, with the head surmounted by a sun with twelve rays. The right hand holds three ears of some grain, probably wheat, while the left, which is raised to the level of the shoulder, but with the elbow flexed, is bearing what seems to be a crescent moon attached to a handle. In the centre of the crescent is a small figure with two faces, the head surmounted by what appears to be a pair of short horns.

MR. N. W. THOMAS, in the November issue of *Man*, excusing the brevity of the account of secret societies in West Africa, published in his recent report, remarks that he was about to be initiated into the Poro Society, which is by no means banned by the Government, and carries on its rites with as little secrecy as a Masonic lodge, had he not been prevented by an order issued by a subordinate official to the chief forbidding him to allow Mr. Thomas to go near Poro, Bundu, or any other sacred bush. This case, now brought to the notice of the local Government, should lead to the reconsideration of such orders, which throw difficulties in the way of ethnographical investigations carried on by the official ethnologist.

MR. H. LING ROTH has issued in the second series of Bankfield Museum Notes, No. 9, the second part of his "Studies in Primitive Looms," this instalment being devoted to those of Africa. He finds no fewer than seven forms of loom in use in the continent: the vertical mat loom, the horizontal fixed heddle loom, the vertical cotton loom, the horizontal narrow band treadle loom, the pit treadle loom, the Mediterranean or Asiatic treadle loom, and the Carton loom. These forms are easily distinguishable, and occupy distinct areas, although in parts they overlap considerably. The most primitive of all the forms, the vertical mat loom, has a wide distribution, extending from the west coast to the east of the Great Congo Basin. The paper is lavishly illustrated by excellent sketches, and forms a valuable contribution to the study of the history of primitive weaving.

IN a paper in the *Geographical Journal* for November (vol. l., No. 5) Miss Newbigin discusses the relationships between race and nationality. After pointing out that the physical differentiæ of race, at least as they occur in the sub-races of Europe, are of little importance under modern conditions, Miss Newbigin maintains that man's power of adaptive response to his environment is incompatible with the view that the practice of a peculiar mode of life endows him with certain fixed characteristics, such as are cited by many writers as racial characteristics. Nationality is not permanent and unalterable. What makes a nation, according to the author's argument, is not only race, or religion, language, history, or tradition, but, partially at least, community of economic interests dependent upon geographic factors. One of the most important of these factors is the existence of an area capable of supporting a large population surrounded by one which becomes progressively less fitted to support such a population. Among nation-making factors she emphasises the existence side by side, within the belt favourable to population, of the most fertile lands, of those best fitted to form seats of industries, and of great nodal points focussing internal and external lines of communication.

IN May, 1903, Dr. C. Gorini, writing in the *Rendiconti del R. Istituto Lombardo* (vol. xxxvi., p. 601), directed attention to the property possessed by the bacillus of typhus and certain other bacteria of climbing up the surface of the agar used for the culture,

while other species failed to do so. This property was afterwards used by Choukevvich, Metchnikoff, and other bacteriologists for isolating the climbing species, notably Proteus, and separating them from others which do not possess the same power. In a recent number of the Lombardy *Rendiconti* (vol. xlix.), Dr. Gorini details further experiments on the method, and gives a general *résumé* of the observations of other writers bearing on the subject.

THE possibility of the transmission of plague by bed-bugs is the subject of an investigation by Lt.-Col. Cornwall and Asst.-Surg. Menon (*Indian Journ. Med. Research,* vol. v., No. 1, 1917). Their conclusion is that the likelihood of the transmission of human plague by bugs in biting under natural conditions is small. The reason for this is that though plague bacilli may survive in the stomach of the bug for nearly six weeks, bugs cannot regurgitate their stomach contents in the act of feeding. If, therefore, bugs transmit plague by biting, they must do so by washing out with the salivary secretion plague bacilli stranded in their sucking tubes, and the bacilli are unlikely to remain in the sucking tube for long after an infected feed.

AN important paper on the zoological position of the Sarcosporidia is contributed by Mr. Howard Crawley to the Proceedings of the Academy of Natural Sciences of Philadelphia (vol. lxvii., part 3). The author arrives at the conclusion that the Sarcosporidia are to be regarded, not as Neosporidia, but as Telosporidia, and as being nearly related to the Coccidiomorpha, a conclusion exactly opposite to that arrived at by Minchin, who regarded these parasites as nearly related to the Myxosporidia. But apart from problems of taxonomy, the author has much to say in regard to this group which is based upon original research, though he has failed to throw any further light on the migration of the product of the zygote into the muscle-cells.

THE skull of the lesser cachalot (*Kogia breviceps*) has recently been investigated by Dr. H. von Schulte, who records the results of his labour in the Bulletin of the American Museum of Natural History (vol. xxxvii., article xvii.). The material at his disposal comprised the skull of an adult female and that of a calf about two-thirds grown, and these are compared with those already described in other museums. The author finds that the cranium of Kogia is subject to a considerable degree of fluctuating variation, and that it is impossible to distinguish sexual characters therein. Finally, he holds that a comparison between the skulls of Kogia and Physeter shows the former to be the more highly specialised form, though both have deviated in different directions from the common ancestral type.

AN interesting account of the high alpine flora of the Upper Mekong in N.W. Yunnan is given by Mr. George Forrest in the *Gardeners' Chronicle* for October 27. Dwarf rhododendrons are the dominant feature of the region from 12,000 to 15,000 ft., forming a moorland vegetation very similar in appearance to our own heather moors. Of the 7000–8000 species of plants already collected by Mr. Forrest, fully 20 per cent. he estimates are rhododendrons. Their wealth, he writes, "is almost incredible . . . each individual seems to have a form or affinity on every range and divide differing essentially from the type." One of his new species, a shrub 1–2½ ft. high, bears masses of brilliant yellow flowers, and was found covering many acres of country.

Kew Bulletin Nos. 4 and 5, which are issued together, are almost entirely occupied by an account of the genus Strychnos in India and the East by the assistant-director. Ninety-two species are now known from this region, twenty-two being described in this paper for the first time. The genus is broken up into four sections on well-marked floral characters, and it is in the section with long-tubed flowers and large fruits that the economic species are to be found. *Strychnos Nux-vomica,* it is found, occurs wild, not only in South India and Ceylon, but also in Cochin-China. The plant from Burma and Siam formerly considered to belong to this species proves to be quite distinct, and is described as a new species under the name of *Strychnos Nux-blanda.* It is of interest that the seeds of this tree, which resemble those of the well-known Nux-vomica, contain practically no alkaloids. Another economic species, *S. Gautheriana,* from French Indo-China, about which much confusion has existed, has also been satisfactorily determined with the help of material at Paris. Several interesting questions of geographical distribution are raised in the introductory pages, and the paper is illustrated with text figures.

IN the *Agricultural Journal of India,* vol. xii., part iii., Messrs. J. H. Barnes and B. Ali give an account of investigations which demonstrate that the progress of reclamation of alkali soils can be effectively tested by measurements of the activity of the oxidising, nitrifying, and nitrogen-fixing bacteria in the soils. Mr. J. N. Sen contributes observations made at Pusa on the occurrence of infertile patches under trees, which indicate that numerous factors are involved, such as competition for light and food, production of toxins, and accumulation of soluble salts. Mr. H. E. Annett contributes the results of further experiments in the improvement of the date-palm sugar industry. The deterioration of the juice by fermentation during collection was found to be largely obviated by coating the earthenware collecting pots internally with lime. Metal buckets, as used in North America for maple juice, were found to be very unsatisfactory. The dark colour of the date-palm sugar (*gur*) was found to be due to the alkalinity of the fresh juice. When this was neutralised before concentrating the juice a very satisfactory light-coloured *gur* was obtained.

MR. T. A. JAGGAR, JUN., director of the Hawaiian Volcano Observatory, occupies sixty pages of the *American Journal of Science* (vol. xliv., p. 161, 1917) with an important and well-illustrated account of recent "Volcanologic Investigations at Kilauea," summarising much that has been published in the Bulletin of the observatory from time to time (compare NATURE, vol. xcviii., p. 436, and vol. c., p. 92). The large photographs of two aspects of Halemaumau, by Mr. Morihiro, of Hilo, are reproduced in a very impressive plate.

THE late Mr. Clement Reid's memoir on the Bournemouth district, published by the Geological Survey in 1898, was the result of his mapping of the superficial deposits; but Sir A. Geikie, as was stated in the preface, then looked forward to the issue of a more detailed account of this very interesting area. Mr. H. J. Osborne White has now prepared a second edition, which is practically a new work (Mem. Geol. Surv., Explanation of Sheet 329, 1917, price 2*s*.), as a guide to the colour-printed map which appeared in 1904. The observations and co-operation of Dr. W. T. Ord, of Bournemouth, have been largely utilised, and the gravels with Palæolithic implements receive just attention. They are regarded as the deposits of streams of much greater volume than those of modern Hampshire. The most effective passage in the memoir remains that in Sir A. Geikie's preface, where he com-

pares the Ordnance Survey map of "Bourne Mouth" in 1811 with that issued in 1893. The present geological map, with its colouring of the plateau gravels of Winton and Boscombe, and of the Bagshot Sands of Parkstone, affords a good explanation of the human development of the district.

ACCOMPANYING the main coal seams in some parts of England are often found seams of inferior coal substances. These frequently resemble cannel coal more or less closely, and are distinguished by giving a large proportion of a very voluminous ash, making them useless for ordinary fuel purposes. In some districts the carbonaceous portion, considered apart from the ash, is comparable in composition with that of a good coal, so that the substance contains a large amount of potential energy, which is at present wasted. Experiments have therefore been made in order to ascertain whether by low-temperature distillation of the waste coal any portion of this potential energy can be made available in the form of oil fuel or other valuable products. An account of these experiments is given by Mr. T. F. Winmill in the Journal of the Society of Chemical Industry for August 31. The main bulk of the liquid products obtained was a hydrocarbon oil of a new type, having a specific gravity of from 0·794 to 0·910, and boiling between the range 150° to 360° C.; it proves to be a mixture of unsaturated and polymethylene hydrocarbons. The only obvious use for the mixture is as a fuel oil. Unfortunately the experiments indicated that treatment of the coal as described would not in present circumstances be a commercially profitable process, the cheapness of the waste coal being more than offset by the fact that no residue of saleable coke is left.

IN a paper which appears in the Proceedings of the Royal Society of Edinburgh for the session 1916–17 Dr. John Aitken gives an account of his investigation of the nature of the nuclei present in air on which condensation of moisture occurs when the air is slightly supersaturated. The supersaturation is produced in the usual way by the expansion of the air by amounts which, in Dr. Aitken's apparatus, were 2, 4, 6, or 8 per cent. The smallest expansion causes condensation on the largest nuclei, and it is repeated until no further condensation occurs. Expansions of 4 per cent. then bring down smaller nuclei, and finally expansions of 8 per cent. bring down the smallest investigated by Dr. Aitken. All are much larger than the "small ions" requiring expansions of 25 per cent. to bring them down. Pure air has fewer nuclei of all kinds than polluted air, which, when freshly polluted by combustion or some other chemical process, has a great number of large nuclei, removable by a 2 per cent. expansion, and many requiring expansions up to 8 per cent. The smaller nuclei disappear faster than the larger. Many substances give off nuclei at ordinary temperatures, but heating facilitates the process, especially if chemical action occurs. Dr. Aitken takes exception to the use of the term ions for these nuclei, even when they are electrically charged.

SEVERAL aeronautical articles appear in the issue of the *Scientific American* for October 6. One article deals with the training of airmen in the States, and lays special emphasis upon the importance of the technical instruction which the men receive, enabling them to understand every detail of the mechanical equipment of their machines. A complete report is given of Capt. Hucks's paper on "A Further Three Years' Flying Experience"—noted recently in these columns. An article on "The Classification of Military Aeroplanes" is of some interest, but most of its contents is well known to those who follow aeronautical progress in this country. A short note on the use of kite balloons deserves comment, as these invaluable aids to artillery are seldom mentioned in our periodicals. Their greatest advantage lies in the fact that they are in direct telephonic communication with the battery for which they are "spotting," as the *Scientific American* duly points out. An excellent plate is given illustrating the leading types of German aeroplanes for 1917, together with a table giving their main dimensions, armament, and engine power. Among the shorter articles is one which informs us that America's first "Blimp" is now in commission. Another short note discusses the advantages of the tractor-pusher type of battleplane, a design in which a small car is mounted in front of the airscrew of a tractor machine, giving the gunner an excellent field of fire. This idea is not new, but has not hitherto met with much approval on account of the mechanical difficulties of supporting the forward car.

Engineering for November 23 contains an illustrated article on the armament of aeroplanes, in which reference is made to the arrangements whereby a machine-gun can be fired through the propeller. The German Fokker of 1915–16 had a fixed quick-firing gun mounted in this way, and combined with the engine, so that its firing synchronised with the working of the engine. This method has been adopted on most of the French and enemy machines. Illustrations of a Parabellum gun and also of a Maxim gun with the synchronising device attached are given in the article. The ammunition used by the Germans is also illustrated; the belt contains ordinary, perforating, incendiary, and explosive bullets. The incendiary bullets are hollow and filled with an incendiary material, the basis of which is phosphorus; these bullets produce a trail of light, the object of which is to fire airships and petrol tanks, and also to enable the gunner to correct his range. The perforating bullets consist of a hardened steel core surrounded by a German-silver cover. The belts contain about 10 or 15 per cent. of explosive bullets, the action of which is that of small explosive shells.

SINCE 1906, when Mr. Palin Elderton's useful volume on "Frequency Curves and Correlation" was published, many further advances have been made in statistical method, and the author has now issued an addendum (C. and E. Layton, 1917) with the idea of bringing the book up to date. The first part deals with the exceptional types of frequency-distribution derivable from Prof. Karl Pearson's differential equation, and the second and third parts describe briefly the calculation of a coefficient of correlation for a two-rowed table by Prof. Pearson's method and the correlation-ratio respectively. The pamphlet should be in the possession of all owners of the original work, a list of errata in which is also given. We have also received a reprint of a short paper on the coefficient of correlation by Mr. W. G. Reed, of the U.S. Weather Bureau, from the Quarterly Publications of the American Statistical Association. The paper gives illustrations of the calculation of the coefficient, and a bibliography of the literature. One illustration seems a little misleading, though it is given as a warning. The correlation between the phase of the moon and the height of high-water is found to be near zero. But the phase of the moon is measured by the number of days after full moon; if it were expressed as a periodic function the correlation would be high.

MR. V. C. SHIPPEE contributes to the *Chemical News* for November 2 an interesting note on pure sodium chloride. A specimen prepared by dissolving metallic sodium in distilled water, neutralising with pure hydrochloric acid, and precipitating with hydrogen chloride

contained a considerable amount of potassium salt as detected by the flame test. After four recrystallisations from distilled water, however, the purified salt contained only 0·01 per cent. of potassium chloride. A sample prepared and purified in the same way, except that caustic soda "pure by alcohol" was employed, contained 0·03 per cent. of potassium chloride, whilst four recrystallisations of a sample of "C.P." common salt gave a product containing 0·07 per cent. of the same impurity. The chief conclusion drawn is that although potassium chloride obstinately persists with sodium chloride, it can be removed by repeated recrystallisations.

A GREAT deal of information is contained in a paper on gas-firing boilers read by Mr. T. M. Hunter at the Institution of Electrical Engineers on November 22. Mr. Hunter believes that there is a great future for this method of firing boilers, despite the unfortunate experiences which have been the lot of many engineers in the past. Mr. Hunter's paper—which is almost a text-book on the subject—should assist engineers to understand and to obtain the proper conditions for economical gas-firing. In connection with the testing of results, the following extract is of interest:—"The apparatus for boiler control will cost a considerable amount, and it must not be overlooked that the best outfit of recording instruments is useless unless a constant and intelligent use of them is enforced absolutely. If, in addition to this, the boilermen and the man in charge of the boiler plant are given a premium for maintaining good results, boiler control will soon develop into a fine art, and prove an important source of revenue." We think that Mr. Hunter's remarks should be noted by owners of boilers. There are numerous cases where CO_2 recorders, pyrometers, etc., have been installed, and are practically ready for the scrap heap after a few weeks' life, when they have served much the same purpose as toys. On the other hand, if these instruments are kept in thorough working order, and if the workmen are taught to take an intelligent interest in their records, it is astonishing what improvements can be effected in the working of the plant.

WE have received a small booklet from Messrs. Watson and Sons (Electro-Medical), Ltd., of 196 Great Portland Street, W.1, entitled "The Sunic Record," dealing with some recent developments in the production of apparatus for the generation and application of X-rays. The work is edited by Mr. T. Thorne Baker, and is an interesting indication of present activity in the British electro-medical industry. In addition to the description of new apparatus, the booklet contains an original article on the suppression of the "inverse" current in induction coils, notes on the X-ray examination of metal castings, radio-active paints, the Coolidge X-ray tube, reviews of books, etc. It is proposed to continue the publication monthly, and the proprietors undertake to send copies to those who will forward their names and addresses.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, W.C.1, have sent us a list of the new books and new editions added to their Medical and Scientific Circulating Library during July, August, and September. As the library contains upwards of 13,000 works dealing with medicine, surgery, astronomy, biology, botany, chemistry, electricity, engineering, geology, microscopy, mining, physics, philosophy, sociology, technology, voyages and travels, zoology, etc., and as any recent book of importance which may be applied for, if not already available, is added to it, it should be of great service to science workers. The list will be sent to any address on application.

OUR ASTRONOMICAL COLUMN.

THE TOTAL ECLIPSE OF THE SUN, JUNE 8, 1918.—The total eclipse of the sun on June 8, 1918, will be visible in the United States along a belt having a maximum breadth of sixty miles, extending from the State of Washington, through parts of Oregon, Wyoming, and Idaho, across Colorado and Kansas, and finally reaching Florida about sunset. The duration of totality will diminish from 2m. 2s. at the coast of Washington to less than half that amount in Florida. It is reported in *Science* (October 26) that Profs. Frost and Barnard have made a personal investigation of certain localities, and have decided upon Green River, Wyoming, as the principal station for the expedition from the Yerkes Observatory. Green River is situated between Cheyenne and Ogden, in the so-called Red Desert, and with a rainfall of about 10 in. per year, and an elevation of 6000 ft., it appears to be one of the most promising stations along the belt of totality. The transparency of the air on the day of the visit of the Yerkes astronomers is described as extraordinary. Denver is a possible observing station, but there appears to be some risk of cloud in the Colorado mountains on a June afternoon. It is probable, however, that a spectrograph from the Yerkes Observatory will be attached to the 20-in. equatorial of the University of Denver. Another site very favourably reported upon is near Matheson, Colorado, about sixty miles south-east of Denver, at an elevation of 6000 ft. On account of the war no British expeditions have been organised for observations of this eclipse.

REPORTS OF FRENCH OBSERVATORIES.—From the official report on the provincial observatories of France for 1916 it appears that a large amount of valuable work has been carried on, in spite of the serious depletions of staff which are recorded. Meridian observations, observations of minor planets and comets, and work connected with the astrographic chart of the heavens are prominent features of the reports. Considerable attention has also been devoted to terrestrial magnetism and meteorology. At Lyons M. Luizet has continued his important studies of short-period variables, and numerous observations of double stars have been made by M. Montangerand at Toulouse. The retirement of M. Coggia is announced by the director of the Marseilles Observatory; M. Coggia joined the staff of this observatory in 1866, and was the discoverer of seven comets, of which Comet VII. (1873) and Comet III. (1874) were especially notable.

STRUCTURE OF PLANETARY NEBULÆ.—An investigation of the internal movements and possible structure of the planetary nebulæ 6543 and 7009 of the N.G.C. has been made by Mr. W. K. Green (Lick Observatory Bulletin, No. 298). In each case several long-exposure photographs of the spectrum were taken with different orientations of the slit, so as to give the radial velocity at a large number of points. The central portion of each nebula gives direct evidence of rotation about the shorter axis, but the outer portions along the major axis seem to be rotating in the opposite direction, and some of the observed velocities follow no regular law. Photometric measurements of plates obtained with the Crossley reflector have been made, and curves are given showing the distribution of intensity along various diameters. Both sets of observations point to a rotating ellipsoidal shell as a possible form, but the luminosity curves which have been calculated for such forms are in disagreement with the observations as regards the major axis. An attempt is made to explain the reversal of direction of rotation at the outer ends by supposing that the central ellipsoid is surrounded by a fainter ellipsoidal shell or ring, which rotates in the opposite direction, but this hypothesis is not considered to be entirely satisfactory.

THE EDUCATION BILL.

THE important conference between representatives of the local education authorities and Mr. Fisher, President of the Board of Education, held in London on November 20, is indicative of the keen interest taken by responsible men in the Education Bill so far as its vital clauses are concerned. Mr. Fisher was not called from his high office as Vice-Chancellor of the University of Sheffield simply that he might promote a measure embodying certain changes in methods of educational procedure and administration, or to increase the bureaucratic powers of the Central Authority with some possible advance in the essential features of education, but in response to a growing and insistent demand, largely induced by the lessons of the fierce conflict in which we are engaged, which has thrown a lurid light upon the defects of our educational system, that Parliament should initiate a liberal measure of educational reform so complete and all-embracing that no child of the nation shall be allowed to escape from its fostering care, however insistent may be the demands of industry.

Mr. Fisher has enthusiastically responded to this demand, and by his speeches in and out of the House has aroused a deep and almost universal desire that his educational reforms, by no means rising to the height of his aspirations or fulfilling the ardent hopes of some educationists, should be given a chance of legislation. Unfortunately, the measure is weighted with certain provisions which, in the opinion of many persons jealous of the claims of local government, are likely to impede the initiative and sap the public spirit and independence of the local authorities. From the tenor of the interview mentioned above it is fairly clear that Mr. Fisher is prepared to go a long way to meet the criticisms offered so far as certain of the administrative clauses are concerned, and there is hope therefore that an agreed measure may result which will dispose of the excuse that the Government cannot find the necessary time for its discussion.

Many measures of reconstruction, to take effect after the war, are afoot, but most of them are likely to be futile of result in the absence of an educational measure of the character Mr. Fisher has placed before the nation. It is accordingly with warm approval that we note that an important body like the British Science Guild has on this ground approached the Prime Minister with a demand that facilities shall be given to enable the Bill, after due consideration and such amendments as may be found necessary, to become law in the course of the present session of Parliament. In all, 331 resolutions, of which 156 are from Labour organisations, have been received by the Government urging that the Bill should be pressed forward with all possible speed. The prospects of the Bill becoming an Act have, indeed, improved greatly during the past few days. On November 23 Mr. Fisher, in a speech at Brighton, declared that the Government intends to pass the Bill, and the Parliamentary correspondent of the *Times* says it is understood that the Government is prepared to consider favourably the giving of facilities for the Bill this session, provided that a guarantee is given that the debates in the House of Commons are limited to a specific number of Parliamentary days.

A large deputation, representative of all parties in the House of Commons, waited upon the Prime Minister on Monday to urge the importance of passing the Bill into law without delay. Mr. Lloyd George was unable to give any definite pledge, but he suggested that if the present session were prolonged it might be possible to take the Bill towards the end of the session, and if not, it would be given priority next session. It is possible, therefore, that the second reading will be taken before Christmas, and, in any case, the Bill is to be given precedence next session if it does not come on before.

MARINE BIOLOGY.

FOURTEEN papers, forming vol. xi. (1917, pp. 360), are issued from the Department of Marine Biology of the Carnegie Institution of Washington. Three papers record observations on the scyphomedusa, *Cassiopea xamachana*, which is common in shallow water near the laboratory at Tortugas, Florida. This medusa, which thrives well in aquaria, is accustomed in nature to a considerable range in salinity and in temperature, and, having commensal algal cells, is in some measure independent of the oxygen supply of the surrounding water. On removing, by means of two circular cuts, the peripheral region, including the sense-organs, and the central stomach, an annular piece of tissue is obtained which is paralysed (owing to removal of the sense-organs), but is capable of stimulation by an induction shock until a contraction wave going in one direction is entrapped in it. Such a wave may maintain itself for days with little change of rate provided the temperature, CO_2, salinity, and H-ion concentration of the sea-water remain constant. Such rings of tissue provide extremely favourable material for the study of variations in the rate of nerve-conduction in natural sea-water and in artificial sea-water solutions. Dr. A. G. Mayer concludes, after many experiments on these rings, that nerve-conduction is due to a chemical action involving the cations sodium, calcium, and potassium (magnesium is non-essential), the sodium and calcium combining with some proteid. The high temperature-coefficient of ionisation of this ion-proteid may account for the high temperature-coefficient of the rate of nerve-conduction.

Dr. L. R. Cary has carried out experiments to test the influence of the sense-organs of the medusa on metabolism and regeneration. The oral arms and stomach having been cut away, a strip of subumbrellar ectoderm, in which alone the nervous elements are contained, was removed along a diameter, and thus nervous connection between the halves of the disc prevented. Comparison of such insulated halves, in one of which the sense-organs were present, while in the other they had been removed, showed that the half-disc with sense-organs always regenerated more rapidly, especially in the early stages. The experiments indicate that the rate of regeneration is simply an expression of the general metabolic activity of an animal, and as such is subject to the influence of the nerve-centres. Dr. S. Hatai gives an account of the composition of normal and starved medusæ.

Prof. E. N. Harvey describes experiments on, and discusses, the chemistry of light-production in animals. He has studied in detail a Japanese marine ostracod Crustacean, *Cypridina hilgendorfi*, in which light-giving material is formed in a gland opening near the mouth and, on agitation of the animal, is readily extruded as minute yellow globules which dissolve in water to a colourless solution. Oxygen is necessary for light-production, in which two substances—"photogenin" and "photophelein"—are shown to be concerned. Photogenin, present in the luminous gland cells, is colloidal, and probably a proteid. Photophelein, which is found in high concentration throughout the body of Cypridina, is crystalloidal and of unknown composition. One part of the gland in 1,700,000,000 of water will give visible light on the addition of photophelein. A similar photogenin-photophelein reaction was found in Japanese fireflies (Luciola). Mrs. Harvey records observations on Noctiluca, the luminescence of which is traceable to granules (photogenin) in the protoplasm, but photophelein could not be demonstrated.

Dr. A. J. Goldfarb has investigated the variability of the eggs of sea-urchins; Dr. H. L. Clark records the habits and reactions of a Comatulid (Tropiometra); Dr. A. L. Treadwell describes several new species of Poly-

chæta; Dr. H. E. Jordan gives an account of the structure of the striped muscle of Limulus, and also traces the embryonic history of the germ-cells of the loggerhead turtle from the emigration of the primordial germ-cells from the yolk-sac endoderm to their arrival in their final positions.

RESEARCH PAPERS FROM THE UNIVERSITY OF SYDNEY.

THE University of Sydney has recently issued (for private circulation) several volumes of reprints of papers by members of its staff and by its research students during the period 1909–16. It is clear that the University is doing its duty in contributing to scientific progress, and in training its best students in the methods of research. Thus in vol. A we have a list of upwards of sixty papers (twenty of which are included in this volume) ranging over the subjects of mathematics, physics, chemistry, agriculture, and engineering; and although, of course, they are of unequal value in the eyes of an expert, they are all concerned with genuine scientific problems, the solution of which means something more than a mere class exercise. One paper is of an exceptional kind, as dealing with a chapter of mathematical history. This is Prof. H. S. Carslaw's Napier commemorative lecture, which gives a clear and interesting account of what Napier's logarithms were (even yet this is often wrongly stated), and of the way in which they were calculated. The other papers are technical, and we must content ourselves with noting those in the complete list which obviously deal with specially Australian matters. These are: (1) Two papers on superannuation and pension funds; ; (2) one on the teaching of mathematics in Australia; (3) one on Australian coalfields and collieries; (4) one on the Hargreaves goldfield, N.S.W. None of these, however, appear in this volume, probably because the stock has been exhausted.

An interesting record of the activities in research of the anatomists and biologists of the University is contained in vol. i., series B. Unfortunately the volume is by no means complete, for of the fifty-seven papers which have actually been published during the period covered (1909–16) only twenty-eight are represented. This, however, is five more than we are led to expect from the table of contents, which is to that extent inaccurate. These papers represent the original research of a dozen different authors, and naturally range over a wide field, from pathological anatomy to zoogeography. The most distinctively Australian contributions are those dealing with the fauna of the great island-continent. The botanical side of biological science is but slightly represented, though we may expect to see a great advance in this direction now that a separate department of botany has been established in the University. A good many of the papers were originally published in English journals, and are already well known to workers in this country. Of the remainder, the Proceedings of the Linnean Society of New South Wales furnish a very large proportion. We may direct special attention to Mr. E. F. Hallmann's "Revision of the Monaxonid Sponges described as new in Lendenfeld's Catalogue of Sponges in the Australian Museum." Such a revision was greatly needed, for the catalogue in question is a singularly unsatisfactory piece of work. Mr. R. J. Tillyard's papers on dragonflies constitute a conspicuous feature of the volume and a very notable contribution to the study of this group of insects, which is dealt with from the different points of view of systematic zoology, geographical distribution, and physiology. We note that Messrs. Hallmann and Tillyard are, or were, both Linnean Mackay fellows in zoology. These fellowships have done much to promote the study of zoology in a country where an immense amount of work still remains to be done before our knowledge of the fauna can be placed upon a really satisfactory footing. The issue of this volume coincides with the retirement of Prof. Haswell from the chair of zoology, which he has so long held. He himself contributes four memoirs to the collection, and we hope that his valuable researches in Australian zoology will long be continued.

Series B, vol. ii., is concerned with geology, pathology, and physiology, the first-named science occupying by far the greatest portion. The papers include a series by W. N. Benson on the "Great Serpentine Belt of New South Wales," where the perennial subject of the connection between radiolarian cherts and pillow-lavas comes up for discussion in the case of rocks of Middle Devonian age. The association of frequent casts of Lepidodendron with radiolaria has raised interesting physiographic questions. The alluvial deposits of Copeton, N.S.W., containing tinstone and diamonds, have been worked since 1873, and Mr. L. A. Cotton has recorded (1914) a diamond in a quartz-dolerite of the district. He regards the basic magma as the true matrix, and does not suggest a derivation from underlying rocks. Prof. Edgeworth David has stimulated so much of the geological work in the University of Sydney that his address to the Australasian Association in 1913 seems very fittingly included in this volume. It deals with the influence of an Antarctic continent, varying in dimensions in geological time, on the climate of Australia, and attributes the cold Permo-Carboniferous conditions to the immense extension of land in the south of the southern hemisphere. Among the physiological papers is one of importance to chemists, by Mr. H. Wardlaw, on "The Accuracy of Neumann's Method for the Estimation of Phosphorus." Though this author's work has been largely concerned with milk, of human or other origin, he has found time for a specially Australian study on the variations of temperature in Echidna.

THE SURVEY OF INDIA.

THE Indian Survey Report for 1915–16 contains nothing of special interest either in the department of exploration or in that of science, but it is a good record of solid work carried out under the direction of Sir Sidney Burrard, curtailed in certain branches by the exigencies of war service, but on the whole a most satisfactory report. The progress made in the topographical mapping of the huge area of India in the ten years preceding 1916 shows that between one-fourth and one-fifth of that area has been completed on various scales and by various methods up to date, but one is left in doubt as to the comparative values of the revision necessary in the mapping of an older date than 1905. The whole of India (or very nearly the whole) must have been mapped by then, on scales which are much the same as those now adopted for various classes of land area. Surely very little revision is necessary in those barren areas (within the frontier) that were mapped on the smaller scales. On the other hand, much of the 1 in. per mile mapping must have required actual re-survey. The area remaining to be mapped amounts to 1·382767 square miles (or thereabouts?), so the Survey of India has still a career before it.

It is worthy of note that thirty-six "Imperial" officers have been withdrawn for active service, and that of that number no fewer than seven have already laid down their lives for their country. A survey party has been attached to the forces in Mesopotamia, and the result of its work will be of special interest, but otherwise no trans-frontier geo-

graphical work is reported. The trigonometrical branch has necessarily been curtailed in its activities, the scientific work of that branch (astronomical, magnetic, and tidal) making up its chief record, with but little reference to the extension of geodetic triangulation. In the department of map publication there has been great activity, the total number of maps published (626,329) during the year being in excess of that of the year previous. T. H. H.

MODERN DEVELOPMENTS OF THE GAS INDUSTRY.

OWING to sudden illness, Mr. W. B. Worthington asked at the end of October to be released from the duties of the presidency of the Institution of Civil Engineers. Mr. Harry Jones, who has been elected to succeed him, delivered the presidential address before the institution on November 6. Mr. Jones is the chairman of the High Explosives Committee, of which Lord Moulton is president, and is the first member of the gas engineering profession who has occupied the chair at the Institution of Civil Engineers. In his address he dealt with modern developments in gas practice, how far the practice has been making itself useful during the war, the fresh prospects it has in the coming time of peace, and, finally, the special qualification of the gas engineer and the work he has to do. Subjoined are extracts from the address.

There has come about in the work of the gas engineer an entire revolution. We used to be called "gas light companies," and the ancient Act of Parliament used to speak of "furnishing a luminous vapour." The revolution that I speak of is in the fact that the use of gas for direct lighting has become almost extinct, and there has been an enormous development of gas as pure fuel, both for domestic and trade purposes, as well as for motor-cars. So extensive has the growth been that it is estimated that, allowing for the use of incandescent mantle burners, not 5 per cent. of the whole output is now used for direct illumination.

The fuel and engine use varies as the towns are more or less industrial, but evidence is not wanting that that also is growing very rapidly. For instance, in the East of London the Royal Mint melts the whole of the coinage by gas furnaces, and Messrs. Rothschild's large refinery uses the same means of smelting. It is remarkable that the gas company which furnishes that supply, having made fuses for war purposes, was found to have by its furnaces melted the metal with such good effect as to produce an alloy so superior that the company has been specially asked to smelt metals on a large scale for the Munitions Department, and is now carrying out a considerable amount of smelting for that department, and you may be interested to learn that this is entirely done by women operators.

Sir Robert Hadfield has stated that in his Sheffield works he uses as much as 500,000,000 cub. ft. of gas per annum for smelting and metallurgical purposes, which represents the output of 45,000 tons of coal. Mr. Hanbury Thomas, the manager of the Sheffield Gas Company, has stated that his company has no fewer than 642 furnaces, consuming 372,000,000 cub. ft. of gas, at work in his district, while 15,116 h.p. gas engines consume 789,000,000 cub. ft. From Birmingham, Manchester, Glasgow, and, indeed, from all the manufacturing towns, we hear similar statements. For such purposes the cleanliness, flexibility, intensity of heat, and control of gas fuel must be very great considerations indeed. The effect of all these uses of gas has been to level the load factor and to remove the maximum demand peak from night-time in midwinter, which was formerly the time when people wanted special light, and often some heat; but to-day the midday cooking hour on a summer Sunday forms the peak in the industrial suburbs of London. There is no hour which demands so much gas as that particular hour on a July Sunday.

An important result of these extended uses of gas appliances has been their ready applicability to the rapid furnishing of munitions on emergency. Acknowledgment is due to makers of furnaces and stove plants for the aptitude and energy shown by them in forcing their output to meet the stress of war, in face of scarcity of materials and labour. Moreover, they have devised a great variety of useful and ingenious plant for facilitating processes of all kinds and for speeding up output, and these have been eagerly accepted by those engaged on munition works.

But, quite apart from general service of this kind, a special direct supply of high explosive material was effectively furnished at short notice in adequate quantities to the War Department, and, although I must not enlarge upon this, I have obtained Lord Moulton's permission to quote to you the full and generous recognition he has given publicly to these services of the gas industry. Among other complimentary and generous expressions he has stated:—"Without the direct aid of the gas industry, and, further than that, the assistance and the knowledge which have been acquired by those who devote their lives to it, it would have been perfectly impossible for this country to have waged the campaign of the last three years, or even for any but a trifling time resist the overwhelming floods of enemies that were poured upon it. When I first was asked to take charge of the manufacture and production of explosives, it took me but a few days to realise my absolute dependence on your great industry. My appeal to the leaders to assist me was made immediately. . . . The response has been so splendid that we have become, I might almost say, affluent where I expected nothing but pauperism, and gradually we have seen ourselves creeping up to an equality with the supplies that our enemies have been piling up year after year in anticipation of a war that they intended to bring upon us, until now I think that our anxiety in this department, which at first was probably the keenest anxiety of all, has passed away through your assistance."

The explanation of this graceful acknowledgment is that at the time the appeal was made there was in the hands of the gas engineer neither a process nor plant for the recovery of one special requirement. For the best process the plant foundations and housing wanted months for execution. But Dr. Carpenter found that by using our own tar as a solvent at a suitable temperature, and diverting part of our existing plant from its normal use, the greater part of the recovery could be effected at once, and that, too, by gasworks below the scale justifying the special plant being erected. Lord Moulton sanctioned this departure, and within a fortnight some of us got going on the Carpenter process, and began to "deliver the goods," which were at that time very vital. So much has been needed since that we have mostly installed the more complete plant on large-scale works, but no profit at all is got out of this; moreover, the service of the chiefs of the staff for organising the co-operation of all the gas undertakings in this work has been furnished by the gas companies without any charge whatever to the Government, and many other accommodations have been gratuitously afforded.

The extended number and variety of processes arising in the prosecution of war service generally in the furnishing of munitions inevitably lead us to the consideration of how far these processes will help us in

times of peace in the future. Inevitably connected with the present distribution of gas as fuel, the chief residual, coke, though not valued as it deserves to be, is a useful smokeless fuel, and can be converted into water-gas, and so made use of as a fuel. Ammonia, when fixed by the acid from our sulphur, is of great value as a fertiliser, and is wanted everywhere for the land. Tar yields chiefly pitch, which is also a fuel, but is needed for the repair of our roads. It is also the parent of many useful by-products. In the past it has been almost a drug in the market, chiefly, it is feared, through our own supineness in allowing the recovery processes largely to leave this country, although the country itself is a large buyer of most of the developed products. The sub-products can, for simplicity, be shortly grouped as follows:—There are ten products which, by their energetic combustion, are capable of explosion for war or motor fuel; there are nineteen various colour dyes of great brilliancy; there are nine drugs and antiseptics, among which are saccharine and aspirin; there are eight perfumes and flavourings; there are ten salts of ammonia and cyanogen, and one sulphur for acid-making and fixing ammonia and cyanogen; altogether fifty-seven, and these may be brought out by further permutations into an almost endless number of interesting and probably, in the future, most valuable products. For war purposes the first ten products and the last eleven are especially useful; but I must not tell you how or why, at any rate at present.

Most of these products, such as the drugs and dyes, have sprung into unexpected importance lately, owing to the limitation of imports due to the war. Their manufacture previously had been very largely appropriated by the Germans, who bought the raw products extensively in this country. Now, more wisely, the larger gas undertakings and newly formed British companies are increasing their production at home.

When the full value of these products is realised under peace conditions steps must be taken to prevent —as has long been done in Germany—the inevitable loss of these values where raw coal is burned to destruction, as in ordinary grates and furnaces under steam boilers. To this end there are important inquiries going on into the question of the conservation of coal as a national asset.

With regard to the general question of the destruction of fuel and of meeting other general needs, considering the now universal demand for gas and coke fuel, pitch for roads, benzol for motor transport, and ammonia for the land, to say nothing of the lesser products, it is surely wise to distribute their production where the population exists, and it is clear that the existing supply of gas, as at present arranged, lends itself to that distribution, as the population lies around the works. This will be true also, in a less degree, of even scattered rural populations, as they eagerly avail themselves of gas as a fuel, the distribution of coal being difficult and expensive in such small quantities. Through the extended use of gas already a very large amount of coal has been displaced for domestic and trade use, to the great improvement of the atmosphere and to the cleanliness of buildings.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The following doctorates have been conferred:—*D.Sc. in Chemistry:* Mr. W. H. Gibson, an internal student, of University College, for a thesis entitled "The Products of Nitration of Toluene." *D.Sc. in Geology:* Mr. C. B. Horwood, an external student, for a thesis entitled "The Gold Deposits of the Rand," and other papers. *D.Sc. in Physiology:* Dr. N. C. Lake, an external student, for a thesis entitled "Report upon an Investigation into the Effects of Cold upon the Body," and other papers.

BY his will the late Dr. Archibald Carmichael, who died in February of last year, has bequeathed the residue of his estate, subject to certain life-rents, to the University of Aberdeen. The value of the residue is estimated at about 12,000*l*., and the income thereof may be applied "for the advancement of the work of the medical side of the said University in such manner and subject to such regulations as the Senatus Academicus of the same University may from time to time determine and think fit." The late Dr. Carmichael was a graduate of Aberdeen University.

THE Bureau of Education, India, has issued the seventh of its "Occasional Reports." It deals with the methods of school inspection in England, and is by Mr. H. G. Wyatt, inspector of schools in the Rawalpindi Division. There is much in the volume which will be of practical value in India, where the history of school instruction and of inspection has passed through phases similar to those in England. The respective functions of general and specialist inspectors are explained with considerable clearness, and the author points out that in India, where specialists are already being employed for certain subjects, such as science and handicraft, the chief lessons from the English experience are that the specialist should keep in close contact with the general territorial inspector and consult him in formulating his general recommendations; that he should see something of the general work of the school, and not confine his attention to his special subject. In the particular case of the inspection of secondary schools, Mr. Wyatt urges that the danger of specialist inspections is that they tend to disregard the aims and character of the school as a school, and consider it too much as an aggregate of classrooms. It is satisfactory to find that India has witnessed a revulsion from "grind" and from examination, and that inspection has ceased exclusively to regard the pupil and the results of instruction, and has tended to focus rather on the class and the teacher's methods.

A COPY has been received of an essay by Mr. Fletcher Durell on the "Reform of the Princeton University Curriculum," which was awarded the Philip Le Boutillier prize in February, 1916. Among other subjects discussed is the function of a college. The view generally held, the essay maintains, is that it is the principal aim of the secondary school to train the mind, so that it shall be a good working machine; that the leading function of the college is to have the pupil use his mind after it is thus trained so as to obtain a general world view; and that it is the essential aim of university education, or of other training subsequent to college work, to master some specialty or life-calling. In other words, after the school has laid the foundation, the college is to teach something about everything, and the university everything about something. But the functions of these three periods of education must overlap. During the secondary-school stage the pupil should assimilate large stores of varied information; at college the development of thought-power should continue, and as comprehensive a grasp as possible of the world's affairs should be secured. The American elective system of deciding a student's course of work is examined, and the treatment of the problem at Princeton University explained. The essay then suggests that to assist students in the choice of a faculty each department should work out a concise statement of the vital principles and most representative facts in its domain, and that in drawing up these statements attention should be directed to the efficiency or value aspects of the principles and facts. Princeton should,

Mr. Durell pleads, aim at developing in her sons the broadest scholarship and deepest general culture, and thus safeguard specialism from vagaries and develop it to the highest pitch.

We have received a report on trade catalogues drawn up by the Technical and Commercial Libraries Committee of the Library Association. The report points out that much information of value to students of science is contained in these catalogues, and that therefore it is desirable that they should be collected and indexed in such a way that students may readily ascertain what new apparatus and inventions have been devised relating to the field of study in which they are working. The Library Association is of opinion that a National Lending Library of books suitable for giving assistance in scientific and industrial research would be of the greatest advantage to technologists. In such a library trade catalogues would hold an important place. It is pointed out that there are peculiar difficulties in indexing trade catalogues. They are seldom dated, and are therefore not easily identified, though the name of the firm by which they are issued can be given. Moreover, they are frequently without any precise description of their contents. The librarian would therefore find it necessary to call in the aid of scientific experts to help in the special indexing required. The report refers to the index to the collection of trade catalogues at the Department of Commercial Intelligence (foreign samples) published by the Board of Trade as an example of an alphabetical subject-index of such catalogues. In view of the special difficulties inherent in collecting and organising the literature of the trade catalogues, and with a view to the widest possible dissemination of the undoubtedly valuable information which these catalogues contain, the committee of the Library Association recommends that proposals be submitted to the leading professional societies and trade journals for the organisation of this class of literature on standardised lines, and possibly for the publication of periodical condensed catalogues of British manufacturing firms.

In proposing his amendment to the Representation of the People Bill, which, as we recorded in our issue for November 15 (vol. c., p. 216), was adopted, giving separate Parliamentary representation with one seat to the University of London, Sir Philip Magnus gave the House of Commons some interesting details of the size and activities of the University. London University consists of a collection of colleges and special schools, about eighty in number, scattered over the County of London. It was founded in the year 1837, and for the past fifty years it has been represented in Parliament. It includes under its ægis three large and important classes of teaching institutions. First, there are the Incorporated Colleges, with endowments and other funds, administered by the Senate of the University. These comprise University College and King's College, each of which is a complete university in itself. The second group of teaching institutions, known as the "Schools of the University," are thirty-three in number, and include the Imperial College of Science and Technology and the School of Oriental Studies, both of which have been established to meet not only national, but also Imperial needs. Somewhat similar in its Imperial character is the School of Economics. But among these thirty-three schools of the University are the eleven medical schools attached to our hospitals, the Royal Holloway College, Bedford College for Women, and other institutions. The third class of teaching institutions, twenty-seven in number, include all our polytechnic schools, the laboratories of which are now rendering valuable help to the Ministry of Munitions. There is also the vast scheme of University Extension Lectures. In the session immediately preceding the war 135 courses of lectures were delivered on philosophy, economics, history, and other subjects, and were attended by 12,902 students. Attached to the University itself are more than 100 professors; and, in addition, there are 1200 recognised teachers; 21,000 members of the University are or have been serving in his Majesty's forces, and of these nearly 700 have already made the supreme sacrifice. At the General Election in December, 1910, the number of graduates who voted at the University of Oxford was 6895, at the University of Cambridge 7145, and at the University of London 6072. The number of graduates, therefore, who voted at the London election was only 823 fewer than those who voted for Oxford, which has the privilege of sending two members to Parliament. The total number of male London graduates is about 11,500.

SOCIETIES AND ACADEMIES.

London.

Royal Society, November 22.—Sir J. J. Thomson, president, in the chair.—C. H. **Browning** and R. **Sulbransen**: Bactericidal properties conferred on the blood by intravenous injections of diaminoacridine sulphate. Whereas antiseptic compounds are in general greatly reduced in their bactericidal activity by the presence of serum, it has been found that salts of 3 : 6-diaminoacridine, both unsubstituted and also various derivatives with methyl groups substituted in the amino-side-chains, or in the benzol-rings, or in both situations, are enhanced in their lethal action on bacteria by the presence of serum; this is also the case with the salt of 3 : 6-diamino-10-methylacridinium. The sulphate of 3 : 6-diaminoacridine has been found specially suitable for intravenous injection on account of its low toxicity. By means of an intravenous injection of diaminoacridine sulphate in a dose which had no harmful effect on the treated animal (rabbit), it has been possible to confer antiseptic properties on the blood so that the serum from a specimen of blood withdrawn as late as from two to two and a half hours after the treatment failed to yield a culture when inoculated with *Staphylococcus aureus* or *B. coli*.—W. D. **Lang**: The Pelmatoporinæ: an essay on the evolution of a group of Cretaceous Polyzoa. The evolution of this sub-family is considered in detail. In order to present the facts intelligibly, they are marshalled according to the following theoretical considerations:—The species lie along diverging lineages; towards the bases or proximal ends of these are forms (radicals) with less calcareous skeletal matter and less elaboration of structure, and these forms appeared earlier in geological time; towards their higher or distal ends are forms with more skeletal matter and more elaborate structure, appearing later in geological time. The evolutionary tendency was to deposit the increasing superfluity of calcium carbonate where it least interfered with the organism's bionomics, if possible in such position and shape as might even be useful to the organism. Sooner or later the race perished through being unable to cope with its constitutional and increasing habit of excessive secretion of calcium carbonate.

Geological Society, November 7.—Dr. Alfred Harker, president, in the chair.—Dr. F. **Oswald**: The Nimrud crater in Turkish Armenia. The Nimrud volcano, one of the largest craters in the world, is situated on the western shore of Lake Van, and was surveyed geologically for the first time by Dr. Oswald in 1898. The western half of the crater is occupied by a deep fresh-water lake, while the eastern half is composed of recent augite-rhyolites. The crater-wall is highest on

the north (9903 ft.). The southern wall only reaches the height of 9434 ft. The crater-wall has slipped down on the south-west to form a narrow shelf. The crater is nearly circular, and the lowest points lie on the long axis. The crater-wall has an external slope of 33° on the south and east. The history of the volcano may be summarised thus:—(1) Its forerunner was the Kerkur Dagh on its southern flank—a denuded mass of grey augite-trachyte. It was probably erupted in the Pliocene period, following the folding of the Armenian area, in which the latest folded rocks are of Miocene (Helvetian-Tortonian) age, consisting of limestones with corals and oysters. It came into existence at a period when the sedimentary rocks could no longer be folded, but were fractured along definite lines, and Nimrud is situated on the great fracture transverse to the Armenian folds at the apex of their bending round from the Antitauric to the Persian direction. (2) Numerous flows of augite-rhyolite built up the vast cone of the Nimrud Dagh, and the increasing pressure on the central vent became relieved by extrusions of augite-trachyte along radial fissures. (3) A presumably long period of inactivity was followed by violent explosions destroying the summit of the cone, and from this crater vast lava-flows of a fluid basalt flooded the country and filled up the valleys, which have since then been eroded a little below their former depth. (4) Further explosions widened the crater, in which a large lake was formed, while the eastern half of the crater became filled by a succession of outflows of augite-rhyolite. (5) The last eruption was recorded in 1441 by a contemporary chronicler, and resulted in the extrusion of a viscous augite-rhyolite along a north-to-south zone of weakness, both inside the Nimrud crater and also to the north. (6) A violent earthquake in 1881, which destroyed the village of Teghurt, was the last sign of activity; but earthquakes are still frequent in the Plain of Mush, and recent fault-scarps are visible along the borders of this faulted depression. Dr. Oswald has presented his model of the crater to the Museum of Practical Geology, and the rocks and slides to the British Museum, where his fossils from Armenia are preserved.

Physical Society, November 9.—Prof. C. V. Boys, president, in the chair.—C. R. **Darling** and A. W. **Grace**: The thermo-electric properties of fused metals. In a previous paper ("Proceedings," vol. xxix., part i.) the authors described experiments with bismuth, the apparatus then used only being capable of furnishing readings up to 560° C. Methods have now been devised in which the metals examined may be heated in the tube of an electric furnace, and observations made up to the temperature limit of the furnace. The metals experimented with were lead, tin, and antimony up to 1000° C., and zinc and cadmium up to temperatures approaching the boiling point. No change in thermo-electric properties was noticed at fusion, except in the case of antimony, which, like bismuth, shows an abrupt bend in the E.M.F.-temperature curve at the melting point, 632° C. This exceptional behaviour of antimony and bismuth is in keeping with the anomalous properties of these metals, both of which expand on solidification; and it is suggested that an allotropic change occurs at fusion in these metals. In the case of lead, which is used as the reference metal in thermo-electric diagrams, it is shown that extrapolation of lines in the diagram beyond 300° led to serious errors, and that although at low temperatures the E.M.F.-temperature curves are approximate parabolas, the departure from this shape above 300° is so marked as to render thermo-electric diagrams of little value.—T. **Smith** and Miss A. B. **Dale**: Triple cemented telescope objectives. The paper describes the four series of triple cemented thin telescope objectives which can be made from two kinds of glass, and determines their construction when first-order spherical aberration and coma are eliminated. The second-order spherical aberration and coma are then calculated, and the former found to be of the same sign for all optical glasses when the surfaces are spherical. The best standard attainable varies very little over a considerable range of glasses. Diagrams show the variations in the curvatures as the glasses are varied for refractive index and dispersion. Contrary to the general belief, it is found that the objectives with least second-order aberrations (absolute values) are not those with the least curvatures for their refracting surfaces.

Linnean Society, November 15.—Sir David Prain, president, in the chair.—Dr. D. H. **Scott**: Notes on Calamopitys, Unger. Calamopitys is a genus of fossil plants, with structure preserved, of Lower Carboniferous age; some species may perhaps go back to the Upper Devonian. The first part of the paper deals with the origin and division of the leaf-trace in *C. americana*. The relations of the five known species among themselves, and of the genus as a whole, are then considered.

Aristotelian Society, November 19.—Dr. H. Wildon Carr, president, in the chair.—Mrs. K. **Stephen**: Thought and intuition. An attempt to bring out the meaning of Bergson's theory of knowledge. Bergson confines his attention to knowledge of existence, and maintains that the best way of knowing existence is to be directly acquainted with it. Thought, which can only give knowledge *about*, is, according to him, a *pis aller*, and he only deals with it so far as it affects the actual experience which we get by acquaintance. Thought and acquaintance defeat one another. Nevertheless, in practice we try to carry on both operations together, and the result is our everyday experience of things having qualities and relations. This experience is a hybrid product. It still has some of the content of the original act of intuition, but whatever could not be used as material for thought has been left out of it, and it has borrowed the form which belongs to the symbols used by thought. It has been "intellectualised." As a new philosophical method, Bergson proposes that instead of limiting our attention to just so much of experience as provides material for thought, and instead of intellectualising our experience, we reverse our mental habits, make an effort to enlarge rather than to limit the whole field of experience with which intuition acquaints us, and attend to it directly without any intermediary.

Royal Meteorological Society, November 21.—Major H. G. Lyons, president, in the chair.—Dr. G. C. **Simpson**: The twelve-hourly barometer oscillation. (1) The existence of the twelve-hourly atmospheric vibrations, one parallel to the circles of latitude and the other parallel to the meridians, first suggested by A. Schmidt in 1890, and investigated by E. Alt in 1909, has been proved. (2) A mathematical expression for the amplitude and phase of each vibration containing the geographical position as the only variable has been obtained. (3) The interference of these two waves has been shown to account very completely for the observed variations in amplitude and phase of the twelve-hourly barometer oscillations, especially in high northern latitudes.—W. W. **Bryant**: Abnormal temperature, with special reference to the daily maximum air temperature at Greenwich. The author proposes that for certain meteorological elements a value shall be defined as "abnormal" if the departure from a well-established normal is at least twice the mean residual, both normal and residual being determined

by smoothing values from a long series of observations. He applies this method to the maximum air temperatures at Greenwich for the period 1841 to 1916, using the first sixty-five years as a standard. The limit thus calculated varies at different times of year from 8° to 12·5° F., so that a fixed limit of 10° would not be applicable. In the analysis it appears that one day in ten is abnormal, the proportion being higher in the months from May to October, and much lower in December and January. Additional tables deal with spells or alternations of heat and cold, and generally with the distribution of abnormal days. The principle is also extended to monthly and annual values, and the effect of a higher limit, three or four times the mean residual, is considered. The relatively hottest month in the period was June, 1846, and the coldest December, 1890, the hottest year 1868 and the coldest 1879.

CAMBRIDGE.

Philosophical Society, October 29.—Prof. Marr, president, in the chair.—G. H. **Hardy**: The convergence of certain multiple series.—G. N. **Watson**: Bessel functions of large order.—H. **Todd**: A particular case of a theorem of Dirichlet.—L. J. **Mordell**: Mr. Ramanujan's empirical expansions of modular functions.—Dr. A. **Kienast**: Extensions of Abel's theorem and its converses.

MANCHESTER.

Literary and Philosophical Society, November 13.—Mr. W. Thomson, president, in the chair.—Miss Constance **Lightbown**: The Siphonozooids of the sea-pens. The author made an investigation of the Siphonozooids of a large number of sea-pens to determine the presence or absence of the mesenteric filaments. It was found that these filaments are usually present in the fleshy forms, but absent in the slender ones. In species of Pennatula and Pteroeides which possess Mesozooids the mesenteric filaments are usually absent.—Dr. J. H. **Salter**: Regional distribution of the native flora of Teneriffe. Particular attention is directed to the evergreen character of the vegetation and the large proportion of shrubby or arborescent forms. The large number of endemic forms is due to the long isolation of the island from the African continent, and to the climatic conditions, which differ considerably from those of the adjacent continent. Among the Compositæ nearly 50 per cent. are endemic to the island, while in such genera as Senecio, Euphorbia, Sempervivum, and others the proportion is still higher. In the coastal region there is a definite foreshore vegetation of cosmopolitan character, including many Chenopodiaceæ (goosefoot family), with only two endemic forms belonging to the genus Beta. On the barren slopes above the foreshore is a desert-like vegetation, in some places ten kilometres in breadth, largely given up to Opuntia (prickly pear), formerly cultivated in connection with the cochineal industry, and now a serious pest in the island. The upper portion of the coastal region comprises all the more fertile portions of the island, and is mainly under cultivation with the aid of a system of water channels. Of the native plants, Sempervivum, Euphorbia, and Dracæna (dragon tree) are the most characteristic of this region, while certain xerophytic ferns, such as Notochlæna, Ceterach, and Cheilanthes, are also in evidence. The "cloud region," commencing at about 2500 ft., runs up to 5000 ft., the lower portion forming the characteristic "Monte Verde," while the last 1000 ft. constitute the "Pinar" (pine woods). The former consists of a transition from scrub to woodland, comprising several species of Cistus (rock-rose), *Erica arborea* (tree heath), *Ilex canariensis* (the native holly), *Myrica Faya* (the candleberry myrtle), and several forms of laurel. The higher-lying pine forests consist mainly of *Pinus canariensis*. Above the cloud belt vegetation is very scanty and mainly characterised by scattered bushes of the broom-like "retama" (*Spartocytisus nubigenus*). There is no true alpine vegetation, but, protected by the retama, several grasses and other plants of small stature are found to occur.

EDINBURGH.

Royal Society, November 5.—Dr. John Horne, president, in the chair.—Dr. J. **Horne**: Opening address: Science applied to industry. The president reviewed the work of the Committee of the Privy Council for Scientific and Industrial Research and of the Advisory Council during the past year. Reference was made to the appointment of a Fuel Research Board; and other administrative changes, such as have been proposed in reference to the Geological Survey, the fisheries, oceanography, geodesy, etc., were also noted among the signs of the times. A special appeal was made on behalf of Dr. Bruce's Oceanographical Laboratory, established for a number of years in Edinburgh, and now suffering lamentably from want of funds.—R. K. S. **Lim**: Period of survival of the shore-crab (*Carcinus maenas*) in distilled water. Shore-crabs survive a short time in fresh water, and the duration of survival is closely connected with the moult cycle. The harder the shell, the longer the period of survival. Examination of the immersed fluid showed the presence of salts which must have been derived from the animal before its death. Thus the survival depends upon the rate of loss of salts and the rate of intake of water, and these factors vary with the condition of the membranes, and therefore with the moult age.

SYDNEY.

Linnean Society of New South Wales, June.—Dr. H. G. Chapman, president, in the chair.—Dr. W. N. **Benson**: The geology and petrology of the Great Serpentine Belt of New South Wales. Part vi., General account of the geology and physiography of the western slopes of New England (concluded).—R. J. **Tillyard**: Studies in Australian Mecoptera. No. 1, The new family, Nannochoristidæ, with descriptions of a new genus and four new species; and an appendix descriptive of a new genus and species from New Zealand. With the exception of a single specimen from Ebor, N.S.W. (5000 ft.), all the representatives of this family were discovered in Tasmania, where they are to be obtained by sweeping the vegetation bordering lakes and small mountain-streams. The insects are of small size, and quite unlike other scorpion-flies in appearance; indeed, they might almost be described as "four-winged Diptera." The venation is much reduced for Mecoptera, and resembles that of the Diptera Brachycera in having R_{2+3}, a straight, unbranched vein. The head is globular, without a prominent beak; the mouth-parts are in a very interesting stage of evolution, the mandibles being absent or vestigial, the labium beginning to form a proboscis, with labellum, but no pseudotracheæ. Wishing to put the "Antarctic theory," as advocated by Hedley, to the test, co-types of the Tasmanian type-species were sent to correspondents in New Zealand, with a suggestion that similar insects should occur there. In reply, Mr. A. Philpott, of Invercargill, sent the pair of specimens herein described, which had been taken in 1913, and put by as "anomalous lacewings."

July.—Dr. H. G. Chapman, president, in the chair.—Dr. A. J. **Turner**: Revision of Australian Lepidoptera. Part vi. (first instalment), Nineteen genera of Australian Lepidoptera. Nineteen genera and forty-six species of the subfamily Boarmianæ, family Geometridæ, are reviewed.—T. G. **Sloane**: Description of a new tiger-beetle from the Northern Territory.—T. G. **Sloane**: The endo-skeleton of the head, the anterior coxæ, and the an-

terior coxal cavities in the families Carabidæ and Cicindelidæ (Coleoptera).

August 29.—Dr. H. G. Chapman, president, in the chair.—E. F. **Hallmann**: The genera Echinaxia and Rhabdosigma (Porifera). The genera were proposed in a recent paper, without definitions, for two species wrongly referred to Axinella and Sigmaxinella respectively. The definitions are now given, with remarks on the probable relationships of the two genera, and re-descriptions of the type-species.—T. G. **Sloane**: Carabidæ from tropical Australia. Twenty-one species belonging to the tribes Scaritini, Harpalini, Odacanthini, Lebiini, and Helluonini are described as new. The Australian genera of the tribe Odacanthini, including four proposed as new, are tabulated.—Dr. A. J. **Turner**: Revision of Australian Lepidoptera. Part vi. (second instalment), Eighteen genera, and eighty-two species of the sub-family Boarmianæ, are discussed.

Royal Society of New South Wales, September 5.—J. H. **Maiden**: Notes on the genus Acacia, No. 111 (extra-tropical Western Australia). Several species are proposed as new to science (one on behalf of Mr. W. V. Fitzgerald), and also a new variety of *A. pyrifolia.* Several imperfectly known species are more fully described, and *A. chisholmi,* hitherto known only from Queensland, is shown to belong to Western Australia. The synonymy of certain species is elucidated, and additional information is given as to distribution and other points.

CAPE TOWN.

Royal Society of South Africa, September 26.—Dr. L. Péringuey, president, in the chair.—W. von **Bonde**: Note on the abnormal development of the genital organs of *Jasus lalandii.*—G. H. **Malan**: The colour-octahedron as a complexity: being suggestions towards a mathematics of colour. Developing certain ideas of Meinong, who contends that the possibility of representing certain well-known facts in connection with colour-psychology by a diagram in the form of an octahedron rests on the presence of certain *a priori* relations incidental to the very nature of colour itself, the writer is led to examine Meinong's contention critically in the light of modern mathematical logic (as expounded by B. Russell). The result of this examination is (1) to show that Meinong's theory, though true in its intention, is at fault in its practical conception of an *a priori* science of colour, and (2) to necessitate a more exact discrimination between the viewpoints of empirical psychology and mathematical science.—Miss A. M. **Bottomley**: A list of South African fungi. This paper is a systematic compilation, with indexes of all the South African fungi in the Government Mycological Herbarium. It records some 276 genera and 800 named species, some of the more important or more interesting of which are illustrated by photographs of actual specimens. Considerable space is occupied by the rusts, the perisporiales, and the pore fungi, three groups which are receiving particular attention in the mycological department.

BOOKS RECEIVED.

British Rainfall, 1916. By Dr. H. R. Mill and C. Salter. Pp. 256. (London: E. Stanford, Ltd.) 10*s.*

How to Collect and Dry Flowering Plants and Ferns. By H. S. Thompson. Pp. 56. (London: G. Routledge and Sons, Ltd.) 7*d.* net.

Lord Lister. By Sir R. Godlee, Bart. Pp. xix+676. (London: Macmillan and Co., Ltd.) 18*s.* net.

Vegetable Forcing. By R. L. Watts. Pp. xx+431. (New York: Orange Judd Co.) 2 dollars net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 29.

LINNEAN SOCIETY, at 5.—(1) Intensity and Direction of Light as Factors in Phototropism; (2) Spore-coloration in Agaricaceæ: Dr. Harold Wager.

FRIDAY, NOVEMBER 30.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—"Thomas Hawksley" Lecture; Heat Engines: Captain H. Riall Sankey.

SATURDAY, DECEMBER 1.

GEOLOGISTS' ASSOCIATION, at 3.—The Gold Coast: A. E. Kitson.

MONDAY, DECEMBER 3.

ROYAL SOCIETY OF ARTS, at 4.30.—Progress in the Metallurgy of Copper: Prof. H. C. H. Carpenter.

ARISTOTELIAN SOCIETY, at 8.—The Development of Criticism: F. C. Bartlett.

VICTORIA INSTITUTE, at 4.30.—Prehistoric Man: his Antiquity and Characteristics: W. Dale.

TUESDAY, DECEMBER 4.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Presidential Address: The Economics of Coal Production: Prof. H. Louis.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Recent Developments in By-product Coking: G. B. Walker.

WEDNESDAY, DECEMBER 5.

GEOLOGICAL SOCIETY, at 5.30.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—Inaugural Trueman Wood Lecture: Discovery and Invention: Sir Dugald Clerk, K.B.E.

SOCIETY OF PUBLIC ANALYSTS, at 5.—The Valenta Number as a Discriminative Test for Oils and Fats: P. J. Fryer and F. E. Weston.—The Composition of Sharps and Bran: H. E. Cox.—Notes on Porcelain: W. T. Burgess.—Note on the Colorimetric Estimation of Iron: E. R. Dovey.

THURSDAY, DECEMBER 6.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Series of Legendre: Prof. W. H. Young.—The Discharge of Gases under High Pressures: L. Hartshorn.—The Electrostatic Problem of a Conducting Sphere as a Spherical Cavity: Dr. Alexander Russell.—The Zeroes of Bessel Functions: Prof. G. N. Watson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Electrical Cooking as applied to Large Kitchens: W. A. Gillott.

CHEMICAL SOCIETY, at 8.—The Relation between Chemical Constitution and Physiological Action: Dr. F. L. Pyman.

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THURSDAY, DECEMBER 6, 1917.

THE CO-ORDINATION OF RESEARCH.

IT is often said in political circles that the way to shelve a subject is to appoint a Royal Commission upon it. The Commissioners collect a large amount of evidence and present a report, but usually the matter ends with the publication of the Blue Book, and nothing is done to carry the recommendations into effect. The Royal Commission on Scientific Instruction appointed in 1870 is an example of this kind. The whole of the scientific instruction given in the United Kingdom from the elementary schools to the universities, and including the museums and scientific work recognised by Government, is surveyed in the report of this Commission, issued in ten parts from 1871 to 1895; and the nation has suffered incalculable loss by not giving heed to its recommendations.

We wonder whether the deliberations and reports of the numerous Committees appointed since the opening of the war to deal with scientific subjects will meet with a like fate; and we anxiously await a sign that the Ministry of Reconstruction intends to produce from the information with which it will be provided a coherent and ordered scheme of national development. Lack of the spirit of organisation and system in both industrial and educational matters has prevented us from taking the lead even when we possessed the necessary knowledge and men to do so. Little has yet been done to show that the Government realises its responsibility for united effort in scientific and industrial advance, and for correlating the work of its various advisory Committees.

We are reminded of this deficiency by a question put by Sir Philip Magnus to the Secretary of State for the Colonies. Sir Philip Magnus asked

"whether any efficient system of co-ordinating the research work now being conducted in the laboratories of our universities, in the National Physical Laboratory, and in the Imperial Institute is being or has been arranged, more especially with the view of bringing the results of such researches into close relation with fresh problems connected with our Colonial trade and with our productive industries in this country and in our Dominions overseas; and whether opportunities are afforded for placing at the service of our manufacturers scientific experts to advise them or to conduct in their factories special investigations; and, if so, under what conditions."

The reply given in the House of Commons on November 29 was as follows:—

"The important questions raised by the hon. member are too large for effective treatment by way of question and answer, but, as he is no doubt aware, the Committee of the Privy Council for Scientific and Industrial Research are in the course of their administration collecting information as to research being conducted in various places and different types of institution which cannot but facilitate the co-ordination of research work which the hon. member desires. Moreover, as he will have gathered from the annual reports of that department, similar organisations have come, or are coming, into existence in other parts of the Empire, which are in close relation with the Research Department in this country. As an example of what is being done in the Oversea Dominions, I would refer the hon. member to the report of the Commonwealth Advisory Council of Science and Industry and the recently published *South African Journal of Industries*, which may be seen in the Colonial Office library. This Imperial machinery will enable those who are engaged in our Colonial trade and in our productive industries to become acquainted with the problems arising in different parts of the Empire, and with the results of any researches now in progress either here or in the Dominions. The hon. member will be aware of the work of the Imperial Institute, which is always willing to put its expert advice at the disposal of manufacturers. As regards the final part of the question, the establishment of research associations, which is one of the main objects of the Research Department, is intended to place at the service of our manufacturers scientific experts who may advise them or conduct in their factories special investigations."

It cannot be said that the information provided in answer to Sir Philip Magnus's question throws much light upon the main subject of co-ordination of research work; it is merely a statement that various bodies are now concerned with research, but as to how far they are organised with common objects, or are co-operative, little is said. What we should like to know is whether the various Committees which have been appointed to deal with national and Imperial matters of scientific importance are working independently and whether their reports published or in preparation are being brought together to produce an organic scheme assigning definite work to different departments. We have not much faith in the influence of the recommendations of these Committees unless a directorate exists to survey them as a whole and to show how they can be carried into effect without overlapping. Either the Ministry of Reconstruction or the Department of Scientific and Industrial Research might fulfil this function, but, so far as we know, neither is doing it. There should be a single bureau of scientific intelligence, where any manufacturer or industrial research worker may obtain information as to the position of published knowledge upon the particular subject in which he is interested and the laboratories

where the subject can be further investigated if necessary. In some large industrial works the head of any department can obtain such information through the works library in which a staff exists to supply it. Something of the same kind is wanted on a national basis; and the most useful purpose the Department of Scientific and Industrial Research could perform would be to institute such a central bureau.

The institution of a great clearing-house for scientific facts and industrial needs would be of supreme value to national development. Intimate connection must be established between workers in the fields of science and industry in order to bridge the gap which exists between scientific investigation and industrial application; and a sure way of accomplishing this is through an efficient and easily accessible intelligence bureau. It is to what has been termed the science of the use of science that the Germans owe to a great extent the place they have attained in the industrial world, though they have often employed unscrupulous means to reach their end. Every large industrial concern should have its own information and records department, which should be planned on the same lines as the central bureau. A few months ago M. Paul Otlet, director of the International Institute of Bibliography at Brussels, published in the Bulletin of the French Société d'Encouragement pour l'Industrie nationale a scheme for an international bureau of this kind having as its functions the collection, classification, and dissemination of all information available which will tend to facilitate or develop industry. Without waiting for this scheme to be established, a beginning should be made with a national clearing-house having like intentions.

Something has been done in this direction at public libraries in different parts of the country. At Coventry, for example, the staff of the Central Library invites inquiries for information, whether made personally, or by letter, or by telephone, and lists of original papers and books dealing with particular technical subjects are issued in printed form and circulated widely among manufacturers and others interested in them. The Glasgow libraries are also issuing lists of works on various technical subjects; and the Library Association, in a report referred to last week (p. 257), points out that a national lending library of books suitable for giving assistance in scientific and technological research would be of the greatest advantage to technologists.

At the annual meeting of this association, held at the beginning of October, Dr. Addison, the Minister of Reconstruction, said that one of the features of the programme which appealed to him was this movement for the formation of technical and commercial libraries and for the setting up of research libraries to suit the particular needs and industries of various districts. It is, however, not sufficient to provide for local needs; there should also be a central library and bureau which would make the position of knowledge in any scientific or technical subject available to any inquirer. Such an institution could be made self-supporting after a time, for manufacturers would not hesitate to pay fees for information required by them to develop their industries. We look to Dr. Addison and the Advisory Council for Scientific and Industrial Research to provide this centralised means of assisting industrial development.

THE ORDER OF NATURE.

The Order of Nature. By Prof. L. J. Henderson. Pp. iv+234. (Cambridge, Mass.: Harvard University Press; London: Humphrey Milford, Oxford University Press, 1917.) Price 6s. 6d. net.

PROF. L. J. HENDERSON, of Harvard, is well known for his important experimental work in bio-chemistry. He is also the author of a previous book entitled "The Fitness of the Environment," in which the inherent fitness for life of the actual physical and chemical world is pointed out in detail. In the present work he has followed up and developed the same thesis.

The first three chapters, beginning with an analysis of Aristotle's distinction between "final" and "efficient" causes, are devoted to an historical survey of ideas on the teleological appearance, not only of organic structure, but of Nature as a whole, considered as a fitting environment for life. Up to the middle of the nineteenth century the fact of a teleological determination of Nature as a whole was admitted by nearly all leading thinkers, however variously this fact was explained. The same admission appears in some of Darwin's writings; but since the publication of the theory of natural selection the teleological conception of Nature has almost disappeared from scientific thought. It has come to be assumed that the reason why the physical and chemical environment appears to be specially fitted for life is simply that life has, by natural selection, been so moulded as to fit its environment. Against this conclusion the main chapters of the book are directed; and the argument is the more remarkable and original since the author accepts without question the theory of natural selection. His discussion of Spencer's conception of evolution is perhaps specially luminous.

The reasoning is based entirely on the general characteristics of life from the point of view of physical chemistry, and particularly from that of Willard Gibbs's analysis of the conditions of stability and variability of physico-chemical systems, living organisms being regarded as such

systems. The difficulty in forming any clear conception at present of the physico-chemical origin of life, or of completely understanding life as a physico-chemical system, is fully acknowledged, but is passed by as presenting a problem which cannot yet be solved owing to the imperfection of existing knowledge.

The general scope of Prof. Henderson's argument, which is presented with much interesting detail, is as follows. The actual distribution of properties among the actual elements, and particularly carbon, oxygen, and hydrogen, is of such a nature as to give a maximum of freedom in the process of evolution.

So far as the known properties of matter are concerned, considering them both quantitatively and qualitatively, every other sensibly different distribution of the properties among the elements would involve great restrictions. Thus conditions are actually established (relatively to other imaginable arrangements of the properties of matter) for the existence of the greatest possible number, diversity, and duration of systems, phases, components, and activities. So it comes about that, in every physical respect, the process of evolution is free to produce more rather than less.

It cannot be that the nature of this relationship is, like organic adaptations, mechanically conditioned. For relationships are mechanically conditioned in a significant manner only when there is opportunity for modification through interaction. But here the things related are supposed to be changeless in time, or, in short, absolute properties of the universe. According to the theory of probabilities, this connection between the properties of matter and the process of evolution cannot be due to mere contingency. Therefore, since the physico-chemical functional relationship is not in question, there must be admitted a functional relationship of another kind, somewhat like that known to physiology. This functional relationship can only be described as teleological.

The author is content with the conclusion that the universe has a teleological arrangement in relation to organic evolution. He carefully avoids all theological inferences, and leaves us with teleological arrangement as an ultimate and mysterious empirical fact. Granted his initial assumption that what we call Nature is nothing but a physico-chemical universe in the sense at present currently accepted, we do not see how his general argument can be shaken. It is not only strikingly original, but also very cogent, and seems certain to exercise much influence on the general trend of philosophical thought in connection with natural science.

If we may offer any criticism of the argument it is this. The conception of a living organism in connection with its environment as a physico-chemical system in the sense of current physical chemistry fails to express the facts of biology. If we call it a system it is a system in which relationship to the whole determines both the constitution and the activities of the parts. These parts and activities, including biological environment, are a function of their relation to the other parts, and therefore to the whole: hence biology deals, not merely with the "efficient" causes of ordinary physics and chemistry, but also with what Aristotle called "final" causes. In biological facts teleology is revealed as immanent in Nature—as of its essence, and no mere accident, and as inherent in environment, and not merely in what we ordinarily distinguish as the bodies of organisms. It seems to follow that the detailed extension of biological conceptions to what we at present regard as the inorganic world can only be a matter of the further extension of knowledge. We have not at present the data for this extension: hence the teleological constitution of the inorganic world can only appear to us as a mysterious empirical fact, and cannot appear otherwise when we assume at the outset that the universe is composed of material units as eternal and unchangeable independent entities. The question inevitably raised by Prof. Henderson's book is whether this assumption is valid, and whether we must not look to the future penetration of physics and chemistry by conceptions akin to those of biology. In the latter case teleological reasoning will take a natural place in the physical sciences.

J. S. H.

HIGHER ALGEBRA AND DYNAMICS.

(1) *A First Course in Higher Algebra.* By Prof. Helen A. Merrill and Dr. Clara E. Smith. Pp. xiv + 247. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 6s. 6d. net.

(2) *Problems in Dynamics (with Full Solutions) for the B.A. Students (Pass and Honours) of the Indian Universities.* By Atma Ram. Pp. 245 + diagrams 16. (Anarkali, Lahore: Atma Ram and Sons.) Price 3s.

(1) OF these two books, the first is interesting as being the work of two American ladies who are colleagues in the same institution. Each of the authors is a Ph.D., and for this and other reasons we may surmise that they received a good part of their training in Germany. They are keenly interested in their subject, have studied its history, and are acquainted with some of its most recent aspects. Thus equipped, they have chosen for their main topics rational, irrational, and (ordinary) complex numbers, logarithms, theory of equations, and elementary calculus. Each chapter is headed by an appropriate quotation; there are a number of historical notes, and some references are made to more advanced textbooks. All this is to the good, and the authors, on the whole, have carried out their programme successfully.

But, unless we are mistaken, this is their first book, and, like all first books, it has the inevitable faults of the beginner, the chief of these being a want of clearness, or a want of detail, just where they are most required. To illustrate this, we will turn to the chapter on the theory of equations. In their "proof" of Descartes' rule of signs they put down the usual +, −, ± diagram, and then say: "The original polynomial had five changes of sign, while the resulting one has at least six, even when the ambiguous signs are so

chosen as to give the smallest possible number of changes. *A little reflection shows that this will always be the case,*" etc. The sentence we have italicised contains the fault referred to. The present reviewer learnt the theory of equations mainly from Todhunter's treatise; the immortal Isaac, in his old-fashioned, unemotional way, does not appeal to his readers' powers of reflection, but does his best to show that in his diagram, and any such, the last row of signs must have at least one more variation than the first. We doubt whether anybody could write, in a reasonable space, a better explanation than Todhunter's; nevertheless, it took us a good deal of reflection to appreciate it. A still more striking instance is in the discussion of Sturm's theorem (p. 219). Here we read: "*It will be seen,*" etc., followed by a statement of the theorem for a particular case. We learnt Sturm's theorem in the first instance from De Morgan's article in the "Penny Cyclopædia." The great Augustus does not say: "It will be seen . . ." (Did he ever say so, in this kind of way?)

One more example, of a rather different kind. Pp. xi–xiv contain a list of formulæ, etc., which the reader is supposed to know, and are given for reference. Under "Binomial Theorem" we have: "*Key number of term.* The number of factors in the numerator of any term, the number whose factorial occurs in the denominator, the exponent of x, and the number subtracted from m to form the exponent of a are always the same number, viz. $n-1$." Doubtless this would be lucid to the late Henry James, but it is not so to us, and we do not believe that it would be so to an average English student, except after a good deal of previous explanation.

Of actual mistakes we have found very few. P. 20 (top) the reasoning is so vague that a student might fairly argue that the proper formula is $n!-r!$ instead of $n!\div r!$; p. 23, in England, if the probability of an event is $3/7$, we say that the odds are 4 to 3 against it, but "odds" may have a different meaning in the States; p. 56, "a variable can have only one limit" is wrong as it stands; p. 79 (bottom) gives a very cryptic rigmarole for differentiating u^c; p. 108, *for* "a number" *read* "a fixed number," otherwise the whole argument breaks down; p. 115, the expansion of $(2-3x+4x^3)/(1-3x+2x^2)$ should be done by synthetic division, not by undetermined coefficients; p. 149, the notes about Napier's logarithms are incorrect (in particular, Napier's logarithms are not "natural" logarithms); p. 169, "i represents the positive square root of -1" is meaningless, especially the "positive."

(2) Prof. Atma Ram's book ought to be extremely useful to those who can use a collection of solved examples in the proper way. It is a sort of abbreviated "Walton" fairly brought up to date, the range being from elementary dynamics and kinematics to central forces, including planetary motion. So far as we have been able to test them, the solutions are all correct, sufficiently detailed, and often very elegant. The English is thoroughly idiomatic, and Prof. Ram is his own printer and publisher. Paper and typography are as good as many Indian Government samples; we wish that the quality could be improved all round. G. B. M.

BIOLOGY OF WATER SUPPLIES.

The Biology of Waterworks. By R. Kirkpatrick. (British Museum (Natural History) Economic Series, No. 7.) Pp. 58. (London: Printed by order of the Trustees of the British Museum, 1917.) Price 1*s*.

SINCE men of science became more intimately associated with engineers in the management of waterworks, questions of animal and plant life in water supplies have been brought more into the foreground, and it is with the object of directing attention to the importance of these questions that the trustees of the British Museum have placed an exhibition in the South Kensington Museum and have published this pamphlet as a guide thereto.

The first section, dealing with the animals associated with water supplies, opens with an account of some experiments made in 1886 on the pipe-fauna of Hamburg, then supplied with unfiltered water from the Elbe. Examples of as many as fifty genera, representing most of the main groups of the animal kingdom, were obtained, and the author gives an interesting account of the life-history of some of the more important, showing how when once established they can rapidly spread to the whole of the system, and in some cases—for example, sponges and molluscs—cause grave restrictions to the flow of water in the pipes.

Under the second heading of "Plants in Waterworks" the author deals chiefly with algæ and bacteria. The former class, when present in excessive amounts, may cause serious choking of filter-beds, and sometimes give rise to unpleasant tastes and odours, but otherwise are an important factor in efficient filtration.

Ordinary bacteria, including those which cause water-borne disease, are not dealt with, but a very full account is given of the dreaded crenothrix or iron bacteria. Several water supplies, both in this country and abroad, notably Cheltenham, Liverpool, Berlin, and Rotterdam, have suffered from this pest, and the author describes in some detail the history of these visitations, which have had the effect not only of almost entirely choking the pipes, but of imparting to the water a deep red colour and an unpleasant odour.

In the last section the question of biology in relation to water purification is dealt with. The theory and practice of slow sand filtration, depending as they do on the formation of a biological film on the surface of the sand, are fully described, and the section concludes with a brief summary of the pioneer work of Dr. Houston on storage.

The pamphlet is profusely illustrated with diagrams and photographs, and is a most useful, interesting, and readable work.

OUR BOOKSHELF.

Laws of Physical Science: A Reference-book. By Dr. E. F. Northrup. Pp. vii+210. (Philadelphia and London: J. B. Lippincott Co., n.d.) Price 8s. 6d. net.

THOSE who at any time have had to look up the laws of some branch of physics rapidly must have felt very seriously the absence of any pocket-book of the type so much used by engineers in which those laws were briefly and clearly stated. They will be in a position to appreciate Dr. E. F. Northrup's book, in which the principal laws are summarised. In a book which so obviously fills a gap in our literature it is perhaps a little ungrateful to point out minor defects. The contrast between the thoroughness of the section devoted to current electricity and the incompleteness and lack of unity of some of the other sections is very marked. On p. 45, for example, the author speaks first of the "force" of a musical sound, and then of the "intensity" of a sound. On p. 47 the velocity of sound is given in terms of quantities expressed in gravitational units, while on p. 51, in another formula for the velocity, tensions are expressed in dynes and masses in grains (probably a misprint for grams). On p. 61 heat energy other than translatory energy is ignored, while on p. 68 many of the general properties of isothermal surfaces and of lines of flow are given as if they held for a point source only. While in magnetism there is a partial definition of unit pole, in electrostatics there is no definition of unit quantity of electricity, and formulæ are given sometimes with, sometimes without, the dielectric constant appearing. In the light section the laws of refraction include the statement that the incident and refracted rays are on opposite sides of the normal, while the laws of reflection contain no corresponding statement. Again, the relative sizes of object and image formed by a spherical mirror are stated on p. 168 as if the only possible objects and images were lines perpendicular to the axis of the mirror. In a second edition it is to be hoped that these defects will be remedied.

The Student's Handbook to the University and Colleges of Cambridge. Sixteenth edition. Pp. vii+703. (Cambridge: At the University Press, 1917.) Price 6s. net.

THE present edition of this useful handbook has been revised to June 30 last. Three important additions only have been necessary in this issue, namely, the regulations for the new English Tripos, the new regulations for the Modern and Medieval Languages Tripos, and certain modifications of the conditions under which prize exercises are to be sent in. The war has occasioned further temporary emergency legislation, and the part of it affecting undergraduates is duly recorded here. The book has been compiled from authentic sources, and its helpfulness to students at Cambridge is undeniable.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Earthquake in Burma.

AN earthquake of some intensity was felt in parts of Lower Burma in the early morning of July 5 last, when the moon was in total eclipse. The only damage reported was at a famous pagoda at Pegu, a town forty-six miles distant by rail from Rangoon, an ancient structure held in great veneration by all Buddhists, and towering 324 ft. over all surrounding buildings. Its golden cone, or umbrella, studded with jewels to the value of many thousand pounds sterling, was shaken down, destroying several smaller pagodas at its base. Fortunately, there seems to have been no loss of life, for the fall happened about 4.40 a.m., when most people were in bed. On festival or fast days there are often thousands of visitors in the precincts of the pagoda, for worshippers come from hundreds of miles distant to this famous shrine, and though the population of the town is less than 20,000, there are often 150,000 there on such occasions. The pagoda trustees and Buddhist elders at once took steps and formed a committee to supervise the removal of the débris and to recover the valuable jewels which had fallen, and in this the civil and police officials rendered every assistance. The Lieutenant-Governor, directly he heard of the disaster, telegraphed to the Deputy-Commissioner:—"His Honour is much distressed to hear of the damage done by the earthquake to your beautiful Shwemawdaw Pagoda, and would be glad if you would kindly convey his sympathy to the pagoda trustees." The trustees wired the following reply:—"We thank his Honour most sincerely for his telegram expressing sympathy at damage done to our beautiful pagoda. Some valuables discovered among the débris."

The largest diamond, which was placed on the top of the golden umbrella, has not yet been recovered, and as Pegu has some thousands of non-Buddhists amongst its population, fears are entertained that many valuable jewels may get into dishonest hands.

The effect of the disaster has, of course, not been wholly bad for everyone. The Burma Railway has had its passenger service from all parts of its line strained to the uttermost. From 5000 to 10,000 people beyond the ordinary traffic are now daily arriving at the town. Taxi-cab and bullock-cart owners are making small fortunes carrying visitors to and from the railway station to the pagoda, situated about a mile distant. These visitors, of course, require food and lodging, so that money to an extent previously unknown, except in holiday or festival time, is now daily circulating in the place.

Pegu is a very ancient town, and was formerly the capital of an independent kingdom. It is mentioned by the first European travellers to Burma in the seventeenth century as a place of great wealth and very populous. It is now one of the largest rice-producing districts in Burma. It will not be very long before its famous pagoda is restored to all its former magnificence, for, although the Burmese are not very familiar or appreciative of co-operation in mundane transactions, all Buddhists are willing to spend money on such a work of "merit" as the restoration or re-building of a celebrated pagoda like the one at Pegu, and putting jewels or valuables at such a height in the air that nobody can see them. This characteristic

seems all the more curious when one notices the hundreds of small, dilapidated pagodas all over the country. These, although they may have been built by their own relatives, the Buddhists usually allow to perish from old age and the effects of the climate, and if one inquires into the reason one gets for answer that such repairs would go to the "merit" of the original builder, not to the repairer. They therefore, if they had the money available, prefer to erect another small pagoda or religious building, when they would be acquiring "merit" for themselves. But when money has to be spent over a famous shrine like the one at Pegu, they seem to have a national, rather than a religious, motive in co-operating, and giving what they can afford—it may be a rupee, or a thousand rupees. Hence money for such an object is always forthcoming.

F. N. BURN.

42 Pyinmagon, Dalla P.O., Lower Burma.

THE NITROGEN PROBLEM.

UNDER this term we have come to denote a question of most pressing importance at the moment. It not only affects our present and prospective national welfare; our very existence as an Empire is directly and immediately concerned with it. This arises from its bearings upon war and agriculture. Nitrogen compounds are absolutely necessary to the manufacture of munitions; they are no less indispensable to the production of food. All nations, therefore, and, for obvious reasons, especially those which are locked together in a life-and-death struggle, are eager to solve it, and under the compelling strain of a dire necessity an extraordinary measure of success is attending their efforts. This is more particularly the case with Germany, owing to the special circumstances of her position, and to the fact that she and the other Central Powers are practically cut off from external supplies of combined nitrogen products.

That Germany should be so far in advance of other nations in this respect is due to her prior recognition, years ago, of certain factors by which, under the very conditions which she dreaded might arise, and which have, in fact, arisen, her actual existence as a nation might be imperilled. The whole history of her association with the nitrogen problem shows that under the semblance of a peaceful venture it was part of the great conspiracy by which she sought to dominate the world. Her first efforts were made in Norway, when she secured a controlling interest in that country's abundant supply of hydro-electric energy, and took the fullest advantage, as is her method, of other people's originality and pioneering efforts. As the problem evolved itself and the political situation became apparently clearer, in proportion as manufacturing processes passed beyond the experimental stage, the great combines, financial and industrial, at the back of the enterprise gradually unloaded their interests in Norway upon an unsuspecting world. It is doubtful whether the whole of the synthetic stages from atmospheric air to ammonia and nitric acid were in full working order at the time the Serajevo tragedy forced the Kaiser's hand; but, as the sequel has shown, they were so far advanced that under the stress of compulsion, aided by the financial support of the State and with no hampering commercial restrictions, they could be made to serve the necessity of the nation. We all remember with what a glow of pride Bethmann-Hollweg revealed to the world that Germany's chemists had at length solved the great nitrogen problem, and thereby secured, henceforth and for all time, as he said, her national security.

Owing largely to our command of the sea, our position, and that of our Allies, in respect to this matter is less acute than that of our enemies. At the same time, apart from the submarine menace, which is transitory, there are elements in the situation which require us to pay very serious heed to it. It would be the greatest possible folly on our part to neglect its study. For there can be no doubt whatever that this question of the fixation of nitrogen and the production of synthetic ammonia and nitric acid has come to stay. Matters of this kind have hitherto been considered as outside the business of the State. Government had no direct interest in them. They were subjects to be left to private enterprise and individual effort. But the circumstances of the time have changed much in our time-honoured and traditional view of the mutual relations of the individual and the State. Public opinion, under the hustling influence of the moment, now compels the State to accept responsibilities and exercise initiative to an extent hitherto undreamt of. Accordingly, a number of official bodies connected with the Government are engaged in the consideration of the nitrogen problem, and we are given to understand that a gratifying measure of success has already attended the systematic research work which has been undertaken at their instance. The attempt should now be made to co-ordinate this business with a view to economy of effort and to bring the whole to a common focus. Government Departments are too apt to encase themselves in water-tight compartments, and departmental jealousies are prone to interfere with unity of action.

We trust that, in view of the urgency and serious nature of the matter, no such trivial considerations will be allowed to operate. The Nitrogen Products Committee of the Ministry of Munitions, constituted more than a year ago under the auspices of the Munitions Inventions Department, is no doubt primarily concerned with the matter, for at the moment the question affects the prosecution of the war and is, therefore, of the first consideration, and every agency should be directed to that issue. In solving the problem as it affects war we incidentally go far to solve it as it affects peace and agriculture. The Comptroller of Munitions Inventions has just issued a report giving a general account of the action which has been taken by his Department in dealing with the subject, and he promises a more complete report based upon the work of the various sub-committees which have been instituted to deal with its several aspects.

We have already directed attention to the action which the United States has taken in connection with the same subject, even before its entrance into the war. A report to his Government by Dr. C. L. Parsons, which has recently been published, contains a mass of valuable information as the result of inquiries and visits to manufacturing plants in various European countries. As regards the account of the arc process of synthesising nitric acid, there is little that is not generally known to experts in this country. Its position as a permanent industry depends largely on local conditions, which are now well understood. Of the Haber process for the production of ammonia, to which the German Chancellor referred in such exulting terms, we have as yet no very precise information concerning plant construction and operation. The method is not at present at work as a manufacturing process outside Germany, and its post-war use in other countries will probably be restricted owing to the practically prohibitive royalty demanded by the Badische Company. It is, however, known to be a difficult, and even dangerous, process to work. Its technical control requires so high a degree of training and skill that Dr. Parsons is assured that if the Badische people were to lose their present staff many months would be required to train another. There can, however, be no doubt of its success. It was first commercially installed in Germany in 1913, when it was said to have produced 20,000 tons of ammonium sulphate. In 1914 this grew to 60,000 tons, in 1915 to 150,000 tons, and in 1916 to 300,000 tons. With the new works recently completed by the Badische Company the 1917 output will be equivalent to upwards of 500,000 tons of ammonium sulphate. As regards cost, it is stated that pure anhydrous ammonia can thus be produced in liquid condition at less than 4 cents per lb. If such is the case, the Haber method is the cheapest process yet known for the production of synthetic ammonia.

The cyanamide process for producing ammonia resembles the arc process of making nitric acid in requiring cheap power for its successful development. In special circumstances it may be able to hold its own with the Haber process, as seems to be realised in Germany, where the method has been subsidised by the Government. It is said that the 1917 German production of cyanamide will be not far short of 400,000 tons. Agrarian interests are endeavouring to induce the Government to establish a nitrogen monopoly to ensure the continuance of the cyanamide industry in Germany, in view of the competition of the Haber process and of coke-oven ammonia after the war.

As regards by-product ammonia and the cyanide process, and the methods of transforming ammonia into nitric acid, there is little in Dr. Parsons's report which is not now common knowledge. Naturally his conclusions and recommendations are more particularly applicable to the circumstances of America, but there is much in his arguments and in the details of his estimates of construction and of operating costs that will necessitate, and will doubtless receive, sympathetic attention in this country.

One fact clearly emerges from this consideration of the nitrogen problem. The combined efforts of the warring nations in seeking the means for their mutual destruction will inevitably ensure the future position of agriculture and the production of cheap food to those who come after us. Out of this evil at least this good will come.

SCIENCE AND OTHER HUMANISTIC STUDIES IN SCHOOLS.[1]

THE report edited by Sir Frederic Kenyon gives evidence of progress towards that agreement among educational experts which is necessary if the construction of a scheme designed for general adoption is to meet with general acceptance. A serious obstacle to this progress is "the great mass of ill-informed public opinion, which distrusts or despises all education, or measures its value by its immediate money-earning capacity." This remark, to be found on the first page of the report, is perfectly true; but it is equally true that another serious hindrance has been the obstinate refusal of so many of the supporters of the old-established classical system to yield ground and to recognise the claims of modern subjects, especially science, to any considerable share in the time, emoluments, and honours which have so long been the portion of the older studies. "The object of the present pamphlet is to record certain attempts that have been made to give a healthier tone to the discussion; to show that a large measure of agreement is possible, . . . and to bring the weight of this agreement to bear on the solution of the outstanding problems which have been the cause of bitter controversy in the past."

The starting point of the movement here described was a letter which appeared in the *Times* of February 2, 1916, in which the educational claims of science were put forward with considerable emphasis. This was followed by the meeting at the Linnean Society on May 3, which has been completely reported in a pamphlet entitled "The Neglect of Science." A rejoinder was published in the Press of May 4, 1916, signed by Lord Bryce and a number of other eminent persons. This letter, though containing some statements which were open to criticism, was conceived in a liberal and conciliatory spirit, which could not fail to have a good effect.

A movement was then begun with the object of securing co-operation among the principal bodies representing "humanistic" studies in their educational aspect, and a conference was held on June 17, 1916, in which representatives of the Classical, English, Geographical, Historical, and Modern Language Associations took part. The result was

1 "Education, Scientific and Humane." A Report of the Proceedings of the Council for Humanistic Studies. Edited by Sir Frederic G. Kenyon. Pp. 32. (London: John Murray, 1917.) Price 6*d*. net.—Committee on the Neglect of Science. Report for the Year 1916–17. (Hon. Sec 17 Grosvenor Road, Westminster, S.W.1.)

the passing of six resolutions, which were published in the Press at the end of August. Of these the most important are the following:—

(1) It is essential that any reorganisation of our educational system should make adequate provision for both humanistic and scientific studies.

(2) Premature specialisation on any one particular group of studies, whether humanistic or scientific, to the exclusion of all others, is a serious danger, not only to education generally, but to the studies concerned.

(3) Humanistic education implies the adequate study of language and literature, geography and history, which in each case should, at the appropriate stage of education, go beyond the pupils' own language and country.

With these resolutions the Teaching Committee of the Mathematical Association and the Committee of the Association of Public-School Science Masters expressed concurrence.

The circular drawn up by the Five Associations spoke of the possible formation of "some central council which could assume a larger responsibility and speak with a wider representative authority." No doubt the formation of such a council is eminently desirable, but it has not so far been brought into existence. The British Academy has appointed a committee which has developed into the Council for Humanistic Studies, the report of which is before us. But the Conjoint Board of Scientific Societies initiated by the Royal Society, with the president, Sir J. J. Thomson, at the head, besides the "Neglect of Science" Committee, which originated in the meeting of May 3, 1916, must not be forgotten. There is also the Education Reform Council inaugurated by the Teachers' Guild, and the report of which was reviewed in NATURE of September 27 last. This body has so far not been consulted by the other associations which have been conferring together.

A step in advance was undoubtedly achieved when a meeting on January 26 last was held between the Education Committee of the Board of Scientific Societies and the Council for Humanistic Studies, with Sir E. Ray Lankester in the chair. In the result it was agreed that more time must be found for the teaching of natural science, especially in the older and more famous schools, and that this time should generally be found at the expense of the classics. All agree in deprecating early specialisation, and it should be noted that this opinion applies to the classics as well as to science and modern languages.

Fortunately, while the experts are trying to make up their minds, some definite action has already been taken by the authorities. The Regulations for Secondary Schools, issued on April 19 last, require the curriculum to provide for satisfactory instruction in the following subjects: (1) English language and literature; (2) at least one other language; (3) geography; (4) history; (5) mathematics; (6) science; and (7) drawing. The report of the committee appointed by the Treasury to produce a scheme of examination for admission to the Civil Service, Class I., was issued on June 20 last. It affords very interesting reading and proposes new regulations of a very important character. The examination is to be divided into two parts. Section A, which must be taken by all candidates, includes the following forms of test: (1) Essay; (2) English; (3) questions on contemporary subjects, social, economic, or political; (4) general principles, methods, and applications of science; (5) translation from a foreign language; (6) a *viva voce* examination. To each of these subjects from (1) to (5) one hundred marks are assigned, and to the *viva voce*, to which the committee attaches great importance, three hundred marks. This is followed by Section B, which includes a great variety of optional subjects generally marked at the same maximum, except mathematics and engineering, which receive twice the number of marks assigned to the other subjects. The report of the Civil Service Committee concludes with a number of specimen examination questions, which are intended to illustrate the views put forward by the committee.

Then there is the Education Bill now before Parliament, according to which elementary education is to be compulsory up to the age of fourteen years. It provides for the establishment of continuation schools and for compulsory attendance at the same. Another clause introduces the interesting and novel proposal to give power to local authorities to afford aid to *research*.

Sir Frederic Kenyon's report contains much that deserves attention, and seems to invite comment, and we cannot do better than advise our readers interested in educational questions to obtain a copy. But they should also read carefully the report of the "Neglect of Science" Committee, which brings out more clearly the claims of the advocates of natural science.

NOTES.

A VERY remarkable statement was made to the Paris Academy of Sciences on October 1 by Prof. H. Vincent, who is director of the great Army Laboratory at Val-de-Grâce, one of the most beneficent institutions of France. He was responsible, in the early months of 1915 and afterwards, for the arrangements in the French Army for the protective treatment against typhoid. He gives the results in a short note with a graphic diagram. He contrasts the terrible havoc wrought in previous wars with the almost negligible death-rate from typhoid in the present war. A heavy incidence of typhoid began in November, 1914; it became much less during March–April, 1915. During this period, November, 1914–April, 1915, the protective treatment could not be effectively carried out at the front, because of the necessities of the war. From April, 1915, onward—except for one very small rise in the summer of 1915, due mostly to paratyphoid fever —the death-rate has been kept almost at *nil*. The line runs steadily along the bottom of the diagram, as one loves to see it. From August, 1915, onward the French Army has received protective treatment, not only against typhoid fever, but also against those two forms of paratyphoid fever which at present are called paratyphoid A and paratyphoid B. The results are magnificent. As Prof. Vincent says:—"For more than two years the French Army at the front has

enjoyed a very remarkable state of sanitation; typhoid and the paratyphoid fevers no longer show themselves, save at a very low degree of frequency. And this, though all the conditions at the front are united to favour the outbreak, spread, and gravity of these diseases. Immense masses of men crowded at close quarters, in such number as one has never seen the like of in any war; incessant renewal of effectives; a long war, and almost ceaseless engagements; near contact of troops, and constant risk of infection from man to man, from patients or from germ-carriers; formidable and continuous contamination of the surface soil by the excreta of germ-carriers; breeding of flies, etc." Yet, in spite of it all, "these diseases may be considered as practically conquered." It is strange to think that one of our "anti-vivisection" societies has been trying to prevent the protection of our own men. Happily, it has failed; the latest returns show that 98 per cent. of them are protected.

In its September issue the *Little Journal*, published in Boston, U.S.A., by the firm of A. D. Little, Inc., indicates what steps have been taken during the past three years to cope with the shortage of dyes in America. Before the war there were only five concerns producing synthetic dyes in the United States. Now, in addition to the coke-oven plants and special phenol makers, there are twenty-three firms producing direct coal-tar products or "crudes," sixty-eight makers of "intermediates," and ninety-eight factories in which the finished dyes are manufactured. Approximately 75 per cent. of the dyes needed by American consumers are now being turned out in the United States, and certain of these products are made in sufficient excess to be available for export to friendly countries, and especially to England. There is still a shortage in such old-established dyes as magenta, methylene-blue, auramine, and methyl-violet. American synthetic indigo is being produced, but not in sufficient amount for the needs of the U.S. Navy. At the end of three years there are "crudes" and "intermediates" in abundance. Two large undertakings, the National Aniline and Chemical Company and the Du Pont Chemical Company, which in chemical research are the peers of the great German factories, are embarking on the manufacture of indigo and other essential dyes. The Americans claim with confidence that their dye-producing firms have the talent, the organisations, the capital, and the will. With these factors in operation the missing 25 per cent. of dyes will soon be provided, and only the odds and ends will eventually be imported.

In a lecture delivered before the London School of Economics on November 16 Mr. Sydney J. Johnstone gave an account of the localities within the British Empire where the chief key-metals, such as tungsten, molybdenum, thorium and cerium, vanadium, etc., occur. Tungsten is found chiefly in Burma and Queensland, and the Empire now furnishes about 35 per cent. of the world's production. The metal is now extracted in the United Kingdom. Molybdenum is also largely worked in this country, and adequate supplies are available from British Colonies and Dominions, especially Australia. Both these metals are of great value for special armament steels, and for the manufacture of high-speed tool steels, on which they confer the property of enabling the steel to retain its hardness when run red-hot. Thoria and ceria, the chief rare-earths in incandescent mantles, are being extracted from the monazite deposits of Travancore and Ceylon, which also contain lanthanum, erbium, didymium, yttrium, and other rare-earths. The monazite in these localities commonly contains about 10 per cent. of thoria, being twice as rich as the similar deposits in Brazil. Occasionally much richer minerals are found in limited quantities in Ceylon—for example, thorianite, which contains as much as 60–80 per cent. of thoria, and has been the subject of much study by the Scientific and Research Department of the Imperial Institute. Mesothorium is a by-product of the working of monazite. Another by-product, zircon, might, it is suggested, be applied for the same purposes as zirconia, *i.e.* the lining of furnaces and other vessels for which a highly infusible material with a low coefficient of expansion is needed. The chief key-metal which is absent, or found only in small quantities in the Empire, is platinum, which is derived mainly from Russia and Colombia. It is possible, however, that it might be obtained in fair quantities, together with palladium, as a by-product in the treatment of nickel-copper ores in Canada.

Prof. A. Righi, foreign member of the Royal Society, has been elected an honorary member of the Institution of Electrical Engineers.

Dr. Arthur Keith, conservator of the museum of the Royal College of Surgeons, has been appointed Fullerian professor of physiology at the Royal Institution.

We notice with regret the announcement of the death on November 28, at Zomba, Nyasaland, of blackwater fever, of Mr. W. C. Mason, Imperial Entomologist, at thirty-three years of age.

Prof. T. B. Wood, Drapers professor of agriculture in the University of Cambridge, is to be appointed a member of the Development Commission in succession to Mr. A. D. Hall, now Secretary to the Board of Agriculture.

Mr. T. F. Claxton, director of the Royal Observatory, Hong-Kong, informs us that, in view of the world situation, it has been decided to discontinue sending the publications of the observatory to the United Kingdom, Europe, and India during the war.

The death is announced in the *Engineer* for November 30 of Mr. James Buchanan, who was a partner in the well-known Liverpool firm of sugar machinery makers. He was associated with the executive of the Liverpool Munitions of War Committee, and undertook important Government contracts for munitions. He was a member of the Institution of Mechanical Engineers.

The Committee on Science and the Arts of the Franklin Institute, Philadelphia, has recommended the award of the Elliott Cresson medal to Col. I. N. Lewis for his invention of the Lewis machine-gun, and proposes to recommend the award of the Howard N. Potts medal to Dr. A. E. Kennelly for his invention of the hot-wire anemometer and his application of this device to the measurement of convection from small heated wires; also that of the Howard N. Potts medal to Prof. L. Vessot King for his improved method and researches in hot-wire anemometry.

Mr. J. C. Merryweather, who died on November 24, at seventy-seven years of age, was the principal member of the firm of fire-engine builders. Mr. Merryweather joined his father in the fire-engine business in 1864, and had a great deal to do with the introduction of steam fire-engines. Under his direction, his firm was the pioneer of the motor fire-engine. He was a member of the Institution of Mechanical Engineers, and received the honour of Commander of the Imperial Order of the Medjidieh in recognition of services rendered in connection with the fire protection of the Khedivial palaces.

WE referred in our issue of May 31 (p. 267) to a proposal to present the portrait of the late Prof. R. Meldola to the Royal Society and the Institute of Chemistry. The total sum received in response to this intimation, which was circulated only among Prof. Meldola's friends, was just above two hundred pounds, which has been paid to the artist, Mr. Solomon, for the portraits. Prof. E. B. Poulton informs us that the portrait presented to the Royal Society will be unveiled by Sir George Beilby on December 18, at 3 p.m.; and that presented to the Institute of Chemistry of Great Britain and Ireland, Russell Square, by the president, Sir James Dobbie, at 4.30 on the same afternoon. Prof. Poulton adds:—"I am sure that subscribers will feel a deep debt of gratitude to Col. S. J. Solomon, R.A., for the generous manner in which he has carried out their wishes, and produced a lasting memorial of a great man, and one that will co-operate with and complete the memories of his friends."

WE regret to announce the death of Mr. Charles Hawksley, on November 27, at seventy-eight years of age. An account of Mr. Hawksley's career is given in *Engineering* for November 30. He was born in Nottingham in 1839, and completed his education at University College, London, when he entered, as a pupil, the offices of his father, the late Mr. Thomas Hawksley, F.R.S. He was a partner with his father from 1866, and continued the business after his father's death in 1893. The firm was associated with waterworks engineering in Great Britain, and also practised in connection with gas undertakings and sewerage works. Mr. Hawksley was president of the Institution of Civil Engineers in 1901, and at the time of his death was a member of council of the Institution of Mechanical Engineers. His death will leave a gap in these institutions not easily filled. In 1907 Mr. Hawksley founded a lectureship of the Institution of Mechanical Engineers to commemorate the centenary of the birth of his father, and by a melancholy coincidence this year's lecture was delivered last Friday evening.

By the death in action on September 28 of Major Harry Clissold, D.S.O., R.E., the world of education sustains a grievous loss. For more than twenty years Major Clissold was on the science staff of Clifton College, where he had himself been educated, and to which until the end of his life he ungrudgingly devoted his exceptional gifts. After taking a first class in the Natural Science Tripos at Cambridge, he became an assistant-master at Marlborough, but very soon returned to his old school. He at once threw himself wholeheartedly into all the interests and activities of school life, intellectual and athletic. This devotion to the interests of the school undoubtedly prevented him, as it has done so many others in similar positions, from making those contributions to scientific knowledge which were to be expected from his great ability and energy. When called upon to take command of the school contingent of the Officers Training Corps he somewhat reluctantly consented, and devoted all his spare time, including many of his holidays, to making himself as efficient as possible in his military duties. Thus, when in 1914 he was offered the command of a new field company of the South Midland Royal Engineers, he accepted it with alacrity. He went to France in April, 1915, in command of a field company, and served with such distinction that he was awarded the D.S.O. in the summer of 1916. Major Clissold's scientific knowledge and habit of mind made him a most valuable officer on technical side, and his constant devotion to the welfare of his men caused him to be one of the most popular officers in the Army. The loss to Clifton is greater than can be described, and to a wide circle of friends in all parts of the globe the world is a darker and a poorer place by his death.

THE supplement to the forty-sixth annual report of the Local Government Board, containing the report of the Medical Officer for 1916–17, has recently been issued. In the general summary Sir Arthur Newsholme directs attention to the need for increased effort to save child-life. In 1914 the excess of births over deaths in England and Wales was 362,354; in 1915 it was 252,201. In 1916 the rate of infant mortality was the lowest on record; there were 29,073 fewer births and 54,099 fewer deaths than in 1915, with a result that the excess of births over deaths for the year was 277,227. Sir Arthur Newsholme expresses the opinion that there should be no insuperable difficulty in reducing the total deaths in childhood to one-half their present number.

SEVERAL articles of topical interest appear in the October number of the *Scientific Monthly* (vol. v., No. 4). Dr. Burgess writes on the applications of science to warfare in France. Prof. Graham Lusk discusses food in war-time. He points out that carbohydrates are the great food fuels of the human machine. Based on their value in calories, proprietary cereal foods are very costly, and it would be a great advance if the value in calories were placed on every food package sold. Dr. Ida Pritchett describes specific preventive and curative therapy by means of serums with special reference to gas gangrene. She believes that an antitoxic serum can be prepared for this condition, and that there is every reason to hope that serum treatment will bring about a decrease in the incidence of, and fatalities from, gas gangrene due to war wounds.

IN *Man* for November Mr. J. Reid Moir describes a piece of wood from the Cromer forest bed which is believed to show traces of human workmanship. The flat end of it appears to have been produced by sawing, and at one spot it seems that the line of cutting has been corrected, as is often necessary when beginning to cut wood with a modern saw. Other examples of pieces of wood pointed by early man are known, and it is believed that Mr. Hazzledine Warren discovered a wooden stake or spear in the ancient implementiferous deposit at Clacton-on-Sea.

MR. NEIL M. JUDD, of the United States National Museum, has just returned to Washington after completing six months of archæological work in Arizona and Utah. He has been engaged in repairing and restoring Betatakin, or Hillside House, one of the most interesting cliff houses in northern Arizona, consisting of nearly one hundred rooms, built on the sharply sloping floor of a crescent-shaped cave. The presence of hidden springs, causing damage to the structure and leading to the accumulation of silt, has been dealt with, and the restoration has been conducted in the most conservative way. The age of Betatakin cliff house is still uncertain, and no definite results can be obtained until the examination of this and other neighbouring ruins has been systematically undertaken.

THE question of the character and origin of the local gods of Egypt is still obscure; but a paper by Prof. Flinders Petrie, published in *Ancient Egypt*, part iii., 1917, does much to clear it up. Prof. Petrie has collected the original records of these cults, and by marking the headquarters of each deity he arrives at important results. Ra appears in only one southern city, and his cult seems to have come from the north-east. The distribution of Mut, the mother-goddess, is decidedly eastern, while that of Amen is

western. Set was certainly brought into Egypt by the desert road, as he had there two centres of the first class, and he was introduced by the Red Sea way to the Eastern Delta. The distribution of the Osiride triad indicates a settlement so early in the land that the worship was generally diffused. Prof. Petrie sums up his article thus: "The geography of the worship of the gods is thus seen to have a considerable value historically, as bearing on their origin and connections. When more complete research into the localities of various uncertain names may extend our identifications, it will be possible to get more light on the sources of Egyptian mythology."

ORNITHOLOGISTS will be grateful to Capt. Hugh Gladstone for his able summary of the life of John Hunt (1777–1842) which appears in *British Birds* for November. John Hunt's "British Ornithology" is a book of great rarity and some merit, but it seems never to have been completed, owing perhaps to the fact that late in life he emigrated to America. But Hunt's claim to a place of honour among British ornithologists does not rest alone on this work, the principal theme of the present communication, which is to be completed in a further instalment.

STUDENTS of bionomics will find much interesting matter in the *Scottish Naturalist* for November, wherein Dr. Eagle Clarke gives the first instalment of a study of the wild life in a West Highland deer forest. These mountainous tracts, he remarks, may be regarded as Nature reserves, retaining still much of their primitive wildness owing to the fact that it is beyond the power of man to effect any material change in the barrenness imposed by their physical conditions. The Corrour Forest, which he so sympathetically interprets, is of great extent, and lies amid some of the wildest mountain country in Great Britain. In his survey he divides the forest into three zones—the alpine, the sub-alpine, and the valley zone—giving an analysis of the fauna, resident and migratory, of each. Incidentally, of necessity, he describes the flora also, but only in its relation to animal life. In the same number the Misses Rintoul and Baxter record some extremely interesting observations on the autumn displays of some of our native birds. Records of isolated cases by E. Selous, J. E. Millais, and H. Eliot Howard can now be compared with the much more extensive collection here brought together, but their precise significance seems as elusive as ever.

THE *Journal of Agricultural Research* (vol. x., No. 4) contains a further important contribution by E. B. Hart, E. V. McCollum, and other colleagues to the question of the physiological effect on growth and reproduction of rations balanced from restricted sources. Previous work has indicated that a ration can be complete and efficient only when it contains protein of adequate quantity and quality, adequate energy, mineral ingredients in proper quantity and proportion, and two factors (vitamines) of unknown constitution which have been temporarily designated as "fat-soluble A" and "water-soluble B." Later work now indicates that to these must be added the important factor of direct toxicity. This can be wholly absent or so mild in its effects as to be entirely obscured when the other essentials of a ration are at an optimum adjustment; or with fair adjustment it may only reveal its effects when the ration is continued over a very long time and the animal involved in the extra strains of reproduction and milk secretion. Rations composed exclusively of wheat products (grain and straw) did not sustain growth with Holstein heifers. Such animals also failed to show œstrus and could not be bred. Marked pathological conditions resulted, such as blindness, feeble and emaciated condition, and abnormal excitability followed by collapse. The responsibility was found to be due in part to the inadequate salt mixture provided by the ration, and in part to inherent toxicity in the grain. By the use of maize stover or alfalfa hay as roughage in place of the wheat straw growth was sustained, but reproduction was only partially successful, weakness commonly appearing in the second gestation. Maize grain *plus* wheat straw allowed sustained growth, but at a slow rate. Additions of salts to this ration made it normal. Addition of wheat embryo to a maize ration caused disturbances, bringing about early abortions, thus indicating a high content of the toxic material in the wheat kernel.

THE report of the Government Cinchona Plantations and Factory in Bengal for the year 1916–17, being the fifty-fifth annual report, is, as usual, a very interesting and instructive document and a remarkable record of efficiency. From it we learn that the acreage under Cinchona has been increased to 2405½ acres, as against the 2295 acres under cultivation the previous year. Figures are given showing the profits of the undertaking during the period 1900–17. For an outlay of 44,84,100 rupees the Government has received 51,24,900 rupees, and has acquired entirely within the period 1905–17 additions to factory buildings, etc., which have quintupled the 1900 output, a large reserve of quinine, 2738 acres afforested with timber and fuel trees, the 2405½ acres of Cinchona, and a large output of other manufactured products, making a total return in cash and readily realisable assets of 1,17,66,634 rupees. Among other medicinal plants grown are Digitalis, *Chenopodium ambrosioides*, and Ipecacuanha.

WE welcome the first number of a new journal, *Psychobiology*, to be published bi-monthly by the Williams and Wilkins Co., Baltimore, U.S.A. (London agents, Cambridge University Press; price per volume, 23s. net), devoted to the field common to psychology and the biological sciences. It will concentrate attention on the interconnection of mental and physiological functions, holding firm to the conception of the organism as a unity. It is edited by Prof. Knight Dunlap, in association with Profs. J. J. Abel, W. B. Cannon, R. Dodge, S. I. Franz, H. S. Jennings, and G. H. Parker—a strong editorial board. In the first number S. I. Franz and K. S. Lashley show that in the white rat removal of large parts of the frontal portions of the brain does not greatly interfere with a learned reaction; D. I. Macht and S. Isaacs discuss the influence of some opium alkaloids on the psychological reaction time; R. Ogden and S. I. Franz deal with recovery from experimentally produced hemiplegia; Prof. J. B. Watson relates experiments which show that the delaying of the nutritive reward for thirty seconds after rats solved a problem box did not alter the learning process; and the editor suggests the theory that the effect of pleasure in "fixing" a reaction may be due to the liberation of a specific hormone, which need not necessarily come from a gland. The whole number is interesting, and we wish the new venture success.

THE outlook of chemistry in the United States, with special reference to the resources of this science in war and peace, is discussed by Prof. Julius Stieglitz in his presidential address to the American Chemical Society, published in *Science* for October 5. Prof. Stieglitz urges for the United States what has been advocated for this country—a declaration of chemical independence. From a chemist's point of view the first consideration necessary for this purpose is that the manufacturer should reckon the chemist "worthy of his hire." The tendency hitherto has been to treat the

chemist merely as an employee instead of co-operating with him as a partner, and this almost invariably dampens his enthusiasm. Secondly, the adoption by the legislatures of a definite national policy as regards the establishment of independence in chemical supplies is advocated. This has already been inaugurated in the question of the fixation of atmospheric nitrogen. Thirdly, wise patent legislation is necessary. Applied chemistry is not wholly industrial: chemistry promises to be the guide, not only of physiologists, but also of bacteriologists, pathologists, and laboratory clinicians. Accordingly, it is essential that the chemistry departments of universities and colleges should keep up their output of men, and maintain a high standard of scientific quality. The great impetus which science has received from the war involves certain dangers. The chief of these is that superior research opportunities and financial returns will attract *all* the best men away from academic life. In the national interest professorial chairs must be occupied by the best men, and to ensure this salaries must be raised. The continued need for pure research untroubled by any possible industrial application of its results must not be forgotten For chemistry in America a brilliant future is predicted provided that the chemist is given a "square deal," and that this science in the universities is placed on the plane occupied by law and medicine.

IN the week following November 20, the anniversary of the Cripplegate Fire, the British Fire Prevention Committee completed its first twenty years' work, which has been carried on entirely by voluntary effort. Among the activities of the committee may be mentioned the promotion of technical research, the initiation of legislation, by-laws, and regulations, the compilation of evidence on the subject of fires, and the preparation of literature and circulars of a precautionary character, more than 250 publications of this nature having been issued. The committee's recommendations have been endorsed by competent authorities in the United States, France, and Russia. Instances of co-operation with other countries are afforded by the organisation of the International Fire Prevention Congress, which was attended by 800 visitors, representing fifteen Governments and 200 municipalities and corporations from all parts of the world, and the International Fire Exhibition, at which a collection of historical and industrial exhibits was shown, and the lessons of many of the great conflagrations of the past decade were discussed. Apart entirely from the propaganda work in fire prevention and the extensive system of publishing trustworthy data, the committee established twenty years ago a complete testing station near Regent's Park for full-sized fire tests, without any encouragement or assistance from the Government whatever. With the advent of the war, which has severely affected professional men, it is unlikely that work of this kind can continue to be dependent solely on the voluntary effort and contributions of the technical professions concerned, and being of great national importance, the committee should be afforded the co-operation and assistance of those public departments which are now concerned in research work and have Treasury or special research funds available for it.

Engineering for November 30 contains an illustrated description of the standard propelling machinery for British standard ships. The main engines are triple-expansion, having cylinders 27 in., 44 in., and 73 in. diameter by 48-in. stroke. There are three boilers of the multitubular return-tube type, 15 ft. 6 in. diameter by 11 ft. 6 in. long, for 180 lb. per sq. in. working pressure, and working under Howden's system of forced draught. The outstanding features of the engine design indicate that it is of Clyde origin. All the designs, excepting the auxiliary machinery, were prepared by one firm, which had extensive experience in machinery for this size of cargo vessel, and were issued complete to various contractors. The advantages of manufacture to one common design were found of convenience in many ways. For example, one firm discovered defects in a soleplate casting; this was at once replaced by a similar casting from another firm, which did not require it immediately, thus preventing several weeks' delay. Orders for the auxiliary machinery, and for all small items, such as valves, branch pieces, etc., were placed with firms which specialise in such work, and furnished all these details ready to fit in place. The positions of the auxiliary machinery were so selected that all erection could be completed before the launch, thus simplifying greatly the amount of pipe-fitting which usually has to be done.

AMONG the forthcoming books of science we notice the following:—"The Education of Engineers," H. G. Taylor (*G. Bell and Sons, Ltd.*); "What Industry owes to Chemical Science," R. B. Pilcher and F. Butler-Jones, with an introduction by Sir G. Beilby (*Constable and Co., Ltd.*); "Synthetic Products," A. R. J. Ramsey and H. C. Weston (*G. Routledge and Sons, Ltd.*); "Elements of Graphic Statics," "Moving Loads by Influence Lines and other Methods," "Strength of Structural Elements," each by E. H. Sprague; "Estimating Steel Work for Buildings," B. P. F. Gleed and S. Bylander; "Machine Shop Practice," G. W. Burley; and "The Theory of the Centrifugal and Turbo Pump," J. W. Cameron (*Scott, Greenwood, and Co.*). *Messrs. Longmans and Co.* have in preparation for appearance in their series of "Monographs on Biochemistry":—"The Development and Present Position of Biological Chemistry," Dr. F. Gowland Hopkins; "The Polysaccharides," A. R. Ling; "Colloids," W. B. Hardy; "Physical Methods used in Biological Chemistry," Dr. S. G. Walpole; "Protamines and Histones," Dr. A. Kossel; "Lecithin and Allied Substances," Dr. H. Maclean; "The Ornamental Plant Pigments," A. G. Perkin; and "Chlorophyll and Hæmoglobin," H. J. Page.

OUR ASTRONOMICAL COLUMN.

ERRATIC CHANGES IN CLOCK RATES.—An interesting suggestion as to the cause of the sudden variations which are sometimes observed in the rate of the three standard clocks of the U.S. Naval Observatory has been made by Mr. W. A. Conrad (*Popular Astronomy*, vol. xxv., p. 522). It has long been noticed that the rates are subject to sudden fluctuations, and that the three clocks usually vary in the same direction at the same time, and by almost equal amounts. As the temperature and pressure controls appear to be beyond suspicion, such changes have hitherto been attributed to imperfect determination of instrumental constants. In seeking the cause of a very bad jump in the rates of the three clocks in February, 1917, it was found that many jumps were coincident with "cold waves," and that on this occasion there was a very marked low-pressure area receding to the east and an abnormally high barometer to the west. It is suggested that the observations of the clock stars may have been affected by lateral refraction, and that a study of the weather map might possibly help to explain the anomalous results which have occasionally been obtained in determinations of the positions of stars.

THE HECTOR OBSERVATORY, NEW ZEALAND.—The report of the Government Astronomer for the past year includes an account of the excellent system of time-signals which has been organised by Mr. Adams, and a plea for the establishment of a wireless time-service. In co-operation with Mr. H. F. Johnston, of the Mag-

netic Department of the Carnegie Institution, a determination of the longitude of Papeete, in Tahiti, was made by wireless signals from the observatory. Local time was determined by means of a theodolite, with a probable error of half a second of time. The longitude of Point Venus was found to be 149° 30′ 1″ west, this being about three seconds of time greater than that usually quoted. The adopted position of the transit instrument at the Hector Observatory is longitude 11h. 39m. 4·27s. east of Greenwich, latitude 41° 17′ 3·8″ south, and height 418 ft. above 1909 mean sea-level. Improved equipment for an observatory so far south is greatly to be desired.

ORBITS OF THREE SPECTROSCOPIC BINARIES.—Three spectroscopic binaries of considerable interest have been further investigated at Ottawa by Dr. W. E. Harper (Journ. R.A.S., Canada, vol. xi., p. 341). The star 20 π Cassiopeiæ, of type A5 and photographic magnitude 5·2, has two luminous components, and the orbits of both have been determined. The period is 1·96408 days, and the range of velocity of each component 235 km. per sec. The orbit is nearly circular. The star 29 Majoris is the typical star of the Harvard class Oe, showing the dark lines of hydrogen, helium, and the ζ Puppis series, in addition to faint emission bands at 4633 and 4688; its visual magnitude is 4·77. The range of velocity is 437 km., and is the largest for any spectroscopic binary yet discovered. The period is 4·3934 days. The emission band 4688 shares in the periodic shiftings due to the orbital motion. The eccentricity of the orbit is 0·156.

In the case of the star Boss 3511, of type F and photographic magnitude 5·3, the range of velocity is 20·5 km., and the period 1·61275 days. The eccentricity of the orbit is 0·067.

PALÆONTOLOGICAL PAPERS.

FOSSIL floras figure largely in the recent publications of the United States Geological Survey. In Professional Paper 98-H, F. H. Knowlton describes thirteen species of plants from the Fox Hills Sandstone of S. Dakota, only four of which were previously known. Remains are scanty, since the beds are marine; but their interest lies in their position between series, the Montana and Laramie formations, that contain abundant plants. The affinities are distinctly with the Upper Cretaceous, and the flora seems to have been well supplied with moisture along a shore-line. E. Wilber Berry (Prof. Paper 91) furnishes a detailed report, accompanied by 117 plates, on "The Lower Eocene floras of South-Eastern North America." The material is derived from the widely spread Wilcox series, which is typically developed in Wilcox County, Alabama, and is known through Mississippi, Arkansas, Texas, Tennessee, and Kentucky. Except for a small fauna (a "faunule") recently discovered in Mississippi, the almost entire absence of animal remains in this vast area is remarkable. Insects, which must have been abundant, are represented merely by the traces of their activities among the plant-remains. The flora is of Ypresian age (p. 152), and contains thirty-nine genera in common with that of Alum Bay in the Isle of Wight. Identical climatic conditions on both sides of the Atlantic are implied.

In Publication No. 254 of the Geological Survey of Queensland, J. H. Reid clears up an important point in connection with the upward range of Glossopteris. Newell Arber had previously, and with good reason, doubted the occurrence of this genus in the Lower Cretaceous Desert Sandstone of Bett's Creek, and it is now shown that there is an unconformity at this locality, and that the remains of Glossopteris belong to the underlying Permo-Carboniferous system.

The problematic *Parka decipiens* of the British Old Red Sandstone has been reinvestigated by the late Lieut. A. W. R. Don and George Hickling (Quart. Journ. Geol. Soc. London, vol. lxxi., p. 648, 1917 for 1915). The vegetable nature urged in 1890 by Reid and Graham is confirmed; but considerable doubt is thrown on the alleged microspores and prothalli, and the general form and vegetative structure are found to be "closely reproduced by some specimens of the recent alga, *Melobesia lichenoides*" (p. 659). A tentative suggestion is made that Parka was a thallophyte with algal affinities.

C. D. Walcott deals with "The Albertella Fauna in British Columbia and Montana" (Smithsonian Miscell. Coll., vol. lxvii., No. 2, 1917), and shows, after field-investigations in a picturesque and mountainous district (plates 1 and 2), that the Mount Whyte Beds containing Olenellus are truly Lower Cambrian and not in the Middle Series, and that the fauna characterised by the trilobite Albertella is found above them, and is of Middle Cambrian age. The author is thus able to accept L. D. Burling's conclusion with regard to the latter fauna, while correcting him in reference to an alleged survival of Olenellus. Numerous species of trilobites are figured.

L. W. Stephenson adds to our knowledge of the exclusively Cretaceous genus of corals, Micrabacia (U.S. Geol. Survey, Prof. Paper 98-J, 1916), and adds six new species and two varieties from Upper Cretaceous horizons in the United States. Bruce Wade (*Amer. Journ. Sci.*, vol. xliii., p. 293, 1917) describes *Busycon cretaceum* as the oldest known of the Fulgurid gastropods. He points out that the family should strictly be called Busyconidæ. It has special interest in being restricted to the eastern region of the United States, from this Upper Cretaceous example to the present day, a fact that is explained by the absence of a free-swimming larval stage.

Several new species of trilobites are described by A. Ware Slocum from the Upper Ordovician Maquoketa Beds of Fayette County, Iowa (Ann. Rep. Iowa Geol. Survey for 1914, published 1916). The new genus Cybeloides is established (p. 212) as distinct from Cybele in the characters of its cephalon. The remarkable genus Sphærocoryphe, with its globular apex to the glabella, is abundant in the upper beds.

The genus Eurypterus is so rare in Upper Carboniferous strata that we welcome the description of a new species from the Coal Measures of Belgium by Xavier Stainier of Ghent (Quart. Journ. Geol. Soc. London, vol. lxxi., p. 639, 1917). A review is given of the eleven Carboniferous species previously recorded.

The largest amphibian known from the Trias of North America is represented by part of the left half of a labyrinthodont jaw from the Newark Beds of Pennsylvania (*Amer. Journ. Sci.*, vol. xliii., p. 319, 1917). The describer, W. J. Sinclair, names the genus Calamops, since impressions of "horse-tail rushes" occur upon the layer encrusting the bone. Surely this is making too much of an accident to an individual. The name "Reed Face" among American Indians would not be extended to others of the tribe.

Joseph Barrell (*Scientific Monthly*, vol. iv., p. 16, 1917) suggests that a climatic change, involving desiccation, reduced the forests that were the habitat of arboreal anthropoids, and thus led to the development of primitive man. "The apes which were trapped in this way in Central Asia were forced to win most of their living on the ground" (p. 23). Pithecanthropus of forest-clad Java must have arisen farther north, and the ancestors of true man must be looked for in Miocene strata in regions which were then passing into steppes. Incidentally, Prof. Barrell seems to accept too readily (p. 21) G. S. Miller's view that the jaw found at Piltdown is that of an ape and not of *Homo dawsoni*.

G. A. J. C.

INDIAN IRRIGATION.[1]

ONE of the earliest and most difficult problems, towards the solution of which man has addressed his ingenuity and resource, is that of artificial irrigation. The rain, we are told, descends alike upon the just and the unjust, but, as regards its geographical

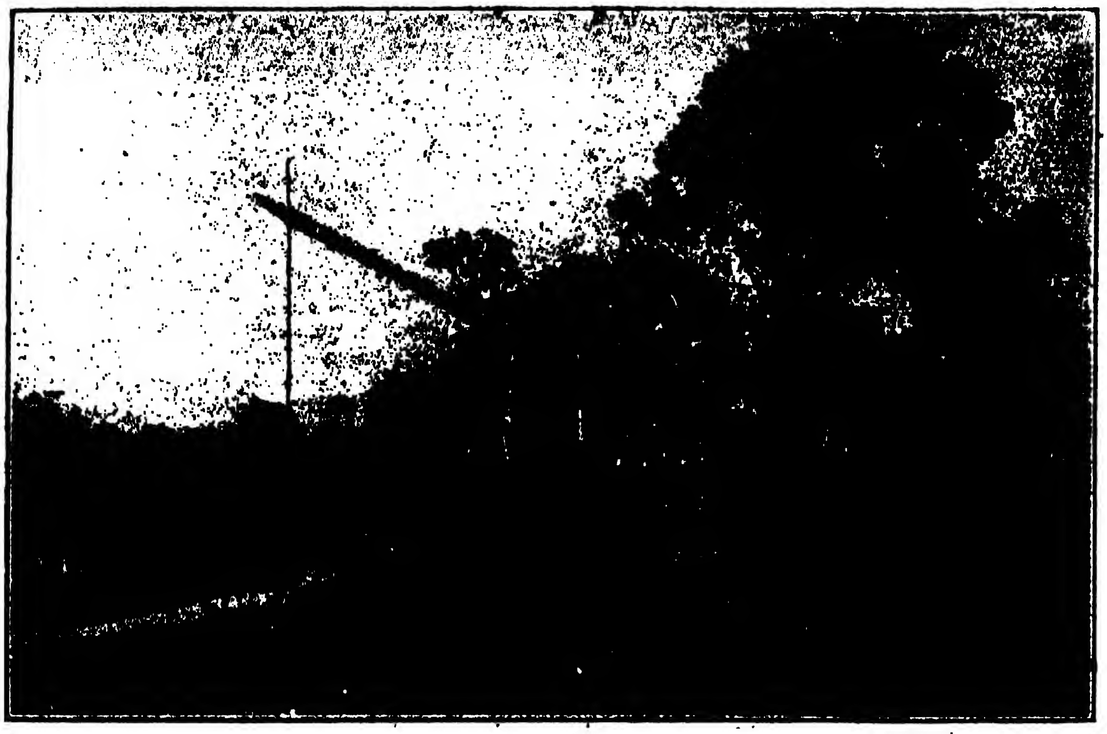

FIG. 1.—Picottah worked by four men (Tuni, Vizagapatam district).

distribution, its incidence is irregular, and at times capricious. Of two localities within a few miles of each other, one will receive copious and embarrassing supplies, while the other will be given a scanty and pitiful dole, which, apart from the satisfaction of immediate human needs, is utterly inadequate for agricultural purposes of any kind. In arid regions, recourse is had to wells, storage reservoirs, and river dams, all of them capable in some degree of alleviating the evil, provided means are at hand to raise and distribute the supplies obtained.

It is particularly interesting, therefore, to read the account given by Mr. R. Cecil Wood of the expedients adopted in the less developed parts of a country like India, where the rudimentary appliances of bygone ages are still in vogue. In such districts labour is cheap and plentiful, and the installation of machinery a costly and troublesome process. It is, therefore, little wonder that the *mhote*, the *picottah*, and the *karim* still maintain an unimpaired popularity. Yet, even in conservative India, centuries old in tradition and routine, modern innovations are making headway, and machinery is ousting the native and the bullock alike from their accustomed tasks. Centrifugal pumps, driven by oil engines of the most recent type, are now to be found at a number of stations, and one of the largest, erected on the Divi island, in the Kistna district, consists of a battery of eight Diesel oil engines, each of 160-b.h.p. capacity, and driving a 39-in. centrifugal pump, giving a total output of more than 570 cub. ft. per sec., or nearly thirteen million gallons per hour.

The introduction of machine-driven pumps is, of course, governed by the available flow of water, and it is manifestly not economical to install a power plant unless it can be effectively utilised. Experience has shown that an engine must be kept at work continuously for four hours in the twenty-four, in order to render its installation remunerative. The Department of Industries in Madras provides portable plant on hire, so that actual tests may be undertaken before any commitment is made.

It is, of course, not practicable in a short notice to deal with all the matters of interest touched upon in Mr. Wood's brochure. Sources of supply and their relative merits, problems of distribution, cost of working and upkeep, systematic cultivation, minimum and maximum requirements, are topics discussed at varying length, and much valuable advice is given for the benefit of the ryot, or peasant land-holder. We may, perhaps, allude to the special difficulty which attaches to agriculture in certain tracts in tropical countries. The rapid and extensive evaporation which takes place causes an upward movement of the subsoil water, with the resultant deposition of salts at or near the surface; certain of these salts, sodium carbonate in particular, and the chlorides and sulphates of magnesium and sodium, are deleterious and produce alkalinity of the soil, under the influence of which crops become thin and sparse, plants acquire an air of sickliness and decline, and foliage is pale and falls

FIG. 2.—Karim (Gōdāvari district).

early. The remedies adopted are principally directed towards a diffusion of the salts and the reduction of the degree of concentration within limits, at any rate, which admit of the maintenance of a state of productivity. The simplest method is that of flooding the areas affected, allowing the water to sink downwards, carrying the salts with it. But, as Mr. Wood

[1] "Irrigation." By R. Cecil Wood, Principal of the Agricultural College, Coimbatore. Pp. 62+33 figures and photographs. (Madras: Department of Agriculture, 1917.) Price 1s. 6d.

points out, this is merely an alleviation, and the only satisfactory method is that which goes to the root of the trouble and removes the salt accumulation entirely by efficient drainage. BRYSSON CUNNINGHAM.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Friday last, November 30, when the council and officers whose names were given in NATURE of November 8 (p. 190) were elected. The annual report of the council was adopted, and the president, Sir J. J. Thomson, delivered his address. Subjoined are a summary of some of the main points in the report of the council, and an abridgment of the president's address.

Report of the Council.

The report of the council records that shortly after the entry of the United States into the war the Royal Society received the following cable message from the National Academy of Sciences at Washington:—

"The entrance of the United States into the war unites our men of science with yours in a common cause. The National Academy of Sciences, acting through the National Research Council, which has been designated by President Wilson and the Council of National Defence to mobilise the research facilities of the country, would gladly co-operate in any scientific researches still underlying the solution of military or industrial problems."

The following reply was dispatched:—

"The Royal Society heartily welcomes the offer of the National Academy to co-operate in scientific researches connected with the war, and will communicate by letter proposals for carrying this into effect."

Steps have been taken by the society to carry the proposed co-operation into effect in connection with the Admiralty, the Ministry of Munitions, and the Department of Scientific and Industrial Research. Experiments on a large scale have been undertaken by the U.S. National Research Council to determine the effect of variations in the milling standard, and in the nature of the cereals employed, upon the digestibility of bread; and parallel investigations are in progress in this country.

Reference is made to the transfer of the National Physical Laboratory to the Department of Scientific and Industrial Research. The scientific control of the laboratory will continue to be exercised by the president and council of the Royal Society, as in the original scheme, but the financial responsibility will be assumed by the Committee of the Privy Council for Scientific and Industrial Research. A working arrangement has been arrived at between the Advisory Council of this body and the Government Grant Committee of the Royal Society by which the society is to inform the council of applications received for sums of money out of the Government grant, and the council is to refer to the society any applications received by it which may be more suitably dealt with by the society than by the council. It is not clear whether this arrangement accounts for the fact that though applications for grants amounting to 5381*l.* were received by the Government Grant Committee, the ordinary grants made amounted to only 1295*l.* The grants made in 1915 amounted to 3344*l.*, and in 1916 to 2482*l.*

The reduction of the magnetic survey of the British Isles was completed in the early part of this year. The important and simple result has been obtained that "formulæ for the geographical components of magnetic force, which are linear in the differences of latitude and longitude all over the British Isles, and satisfy the condition for a potential, give as close a representation of the main features as the more elaborate and empirical expressions obtained by Rücker and Thorpe." Accordingly "disturbances" are defined as the differences between the observed values and those calculated from this potential. Direct comparison of the primary observations in the two surveys has been made, and shows that, with few exceptions, the secular change is remarkably uniform in the various districts. The mean annual change for these islands generally has been in $H+13{\cdot}2\gamma$, in $D-6{\cdot}1'$, and in $I-1{\cdot}2'$. The annual change in H and I has been distinctly less in the north, but the change in D is practically constant all over. The disturbing forces in the two surveys are also in good general agreement, although the differences, which are chiefly in the vertical component, suggest a modified view of "ridge" lines. The two surveys, however, prove that these disturbances are not mere errors of observation, but are due to regional and local causes. That they arise from magnetic material (presumably iron) seems undoubted, and the only questions are whether this material is concentrated locally or disseminated widely, and whether it is near the surface or deeply seated. The possible economic importance of this led to the appointment of an Iron Ore Committee, to consider whether magnetic observations might be of assistance in locating iron ore. A more detailed survey of the Melton district was made by Mr. G. W. Walker this autumn, by aid of a grant from the society, and this is being followed up by a petrological survey under the director of the Geological Survey.

The possibility of introducing a more convenient system of timekeeping at sea has lately been under consideration, both in this country and in France. The conclusions reached at a conference under the chairmanship of the Hydrographer to the Admiralty, in which representatives of scientific societies took part, are included in the report of the council. The most practical method of obtaining uniformity is considered to be the establishment, outside territorial waters, of zones corresponding with the hourly zones on land. It is proposed that the zone extending from $7\frac{1}{2}°$ east to $7\frac{1}{2}°$ west of Greenwich should be the zero zone, and that the other zones west and east should be respectively described as *plus* or *minus*, with an indication of the actual correction required for reduction to Greenwich time and date. On this system $+12$ would be the half-zone east of the "date line," and -12 the half-zone west. Any alteration of the time of clocks in ships should always be one hour, but the instant of making the change need not necessarily be that of passing to a new zone. In the case of self-recording meteorological instruments, which it would be difficult to adjust for changing zone time, Greenwich time is considered most convenient, but ship's time should be used for the regular observations. If the proposed zone times be generally adopted, it is recommended that the receipt and dispatch of telegraphic and other messages should for the immediate future be recorded in zone time; but, eventually, it would be most convenient for such purposes to adopt Greenwich time throughout the world.

Presidential Address.

The extent to which men of science in this country are engaged on investigations connected with the war is scarcely realised, except by those who have to try to find the men for any new piece of work of this kind which may have to be put in hand. It is a matter of the greatest difficulty to find any competent person who is not already engaged on such work. Professors from our Colonies have come back to help at home, and in some cases have brought their demonstrators

and senior students with them. The importance of having an ample supply of trained scientific workers, and the necessity for this country to increase its supply in the future, could scarcely be proved more incisively than by our experience in this connection.

The need for a greater appreciation of the value of science has been brought into such prominence by the war that most of those who have advocated the claims of science in education have not unnaturally laid the greatest stress on the importance of science to the welfare, the power, and even the safety of the nation. The supporters of literary studies have, on the other hand, dwelt mainly on the fact that literature broadens a man's horizon, and gives him new interests and pleasures, that it teaches him how to live, if not how to make a living. The result of this divergence of appeal has made the discussion appear, to those who watch it from outside, almost like a discussion between spirituality and materialism, or between a saint and a man of business.

Echoes of this sentiment are to be found in the opinions expressed by some members of the Labour Party; there is a tendency to regard science teaching with suspicion, as being intended to make the working man more valuable to his employer rather than to increase the brightness and interest of his own life.

I recognise—and I know no man of science who does not—the necessity of literary studies as a part of the education of every boy and girl, but I must protest against the idea that literature has a monopoly in the mental development of the individual. The study of science widens the horizon of his intellectual activities, and helps him to appreciate the beauty and mystery which surround him. It opens up avenues of constant appeal to his intellect, to his imagination, to his spirit of inquiry, to his love for truth. So far from being entirely utilitarian, it often lends romance and interest to things which to those ignorant of science make no appeal to the intellect or imagination, but are regarded by them from an exclusively utilitarian point of view. A knowledge of science brightens and widens the intellectual life, and is a constant stimulus to the intellect and imagination.

The question of the position of science in schools is of vital importance; I think that we ought also to pay attention to the need for sustaining and stimulating in after-life the interest in science which we hope will have been aroused at school. We should encourage and develop efforts to bring to the notice of the public those results of science which are of general interest. I am not sure that we do all that is possible in this direction, and yet it seems our duty to the community to give it everything which can add interest to life and stimulate the intelligence; to do everything in our power to increase appreciation and interest in science among our citizens; without such appreciation a full utilisation of the resources of science and adequate encouragement for its development are impossible in a democratic country.

There are many results of general interest embodied in papers which could not be read by anyone who was not a specialist in the subject. I will give one instance, taken from what might seem a somewhat unpromising branch of science—arithmetic. If we take the numbers in order 1, 2, 3,... we see that there are some, such as 3, 5, 7, 11, which cannot be divided by any number smaller than themselves; these are called prime numbers; the number of such primes which are less than a given number is a matter of very considerable importance, and Gauss, many years ago, gave, without any rigorous proof, a rule about it. The rule was tested by actual trial for numbers up to a thousand millions, and, as it was found to be true over that immense range, it was accepted as universally correct in spite of the absence of a satisfactory proof. Quite recently, however, Mr. Littlewood, one of our fellows, has shown that, in spite of this apparently overwhelming evidence in its favour, the result is not general, but the numbers, for which it breaks down, are so enormous that it would be quite beyond the powers of human endurance to detect its failure by actual trial. I may say, in passing, that, enormous as these numbers are, they are mere nothings compared with what we have to deal with in many branches of physics. Here, then, we have a result which has satisfied, and apparently always will satisfy, any direct test that can be applied to it, and yet is not generally true; there seems to me to be something of a tragedy, perhaps the suspicion of a sermon, in this investigation, which is in a paper of a highly technical character, quite unintelligible to anyone who was not an expert mathematician.

There are many results of this kind, known only to specialists, but which would interest a very much wider circle of readers if they could be brought to their notice. Unfortunately, there does not seem to be at present any recognised method of doing this. There are excellent periodicals with special circles of readers which might find a place for some of them, but these only reach a minute fraction of the educated public. There is room, I think, for a periodical which would appeal to a much wider circle, which should contain interesting and trustworthy accounts of results of interest, not only in science, but also in the other subjects included in a general education.

The desirability of a journal of this kind was recently brought before the notice of the Executive Committee of the Conjoint Board of Scientific Societies. If it could be established, it would, I believe, do good work by stimulating the intellectual life of the nation and increasing the appreciation of science throughout the country.

The Medallists.

COPLEY MEDAL.—M. Emile Roux, Pasteur's chief collaborator, succeeded him as the director of the Institut Pasteur, which he has successfully developed and maintained as the foremost school of bacteriology, both for teaching and for research. From the early 'eighties, when he was associated with Pasteur and Chamberland in the study of anthrax and the production of vaccines against this disease, he has played a leading part in the development of our knowledge of the processes of immunity. His work with the distinguished veterinarian Nocard upon the contagious pleuro-pneumonia of cattle was the first demonstration of the existence of "ultra-microscopic," or, as they are now termed, filterable viruses as disease-producing agencies; his work with Yersin, the first full study of the bacillus of diphtheria and of its toxins. He shares with the late Prof. Behring, of Marburg, in the introduction of diphtheria antitoxin as a practical means of prophylaxis and cure, and with him as co-founder of serum therapeutics was awarded the Nobel prize. All the leading French bacteriologists of our generation have been his pupils.

ROYAL MEDALS.—Dr. Aitken is distinguished for his lifelong researches on the nuclei of cloudy condensation, embodied in a series of memoirs communicated to the Royal Society of Edinburgh. The latest of these appeared in the present year. Dr. Aitken's discoveries opened up a new field of investigation in physics, and constitute a chapter of knowledge of great importance intrinsically and in their relation to the physics of meteorology. Dr. Aitken, who has pursued his work as an amateur, has displayed great experimental ingenuity, and his remarkable construction of the "dust-counter" has provided a permanent scientific appurtenance of precision to the physicist and

climatologist. Among other contributions to science, Dr. Aitken has made important advances in our knowledge of the formation of dew.

Dr. Smith Woodward has been for many years keeper of the Department of Geology in the British Museum, and has published a very large number of valuable memoirs on fossil vertebrates, especially fishes. He has also published an important "Catalogue of Fossil Fishes in the British Museum," and his "Outlines of Vertebrate Palæontology," published in 1898, is a standard text-book on the subject. Dr. Smith Woodward's original memoirs are too numerous to mention, but they have secured for him a world-wide reputation, and he is universally regarded as one of the highest authorities on vertebrate palæontology.

DAVY MEDAL.—M. Albin Haller, professor of organic chemistry at the Sorbonne, Paris, founder and first president of the International Association of Chemical Societies, and at the present time the most representative chemist of France, is distinguished for his many and important contributions to chemical science during the past forty years. His investigations have covered a very wide field in the domain of organic chemistry, the most important being those dealing with compounds belonging to the camphor group. He has maintained over a long period of years the reputation of the Sorbonne School of Chemical Research, created by Dumas and Wurtz, his predecessors in the chair.

BUCHANAN MEDAL.—Sir Almroth Edward Wright was the first (1896) to apply laboratory knowledge on typhoid immunity to the protection of human beings against enteric fever. Against formidable opposition he carried out a long series of observations with the highest scientific acumen and unsurpassed technique and laid the foundations for the effective elimination of enteric fever from the armies of the world. Nothing of importance has been added to his work down to the present time.

HUGHES MEDAL.—Prof. C. G. Barkla's investigations have mainly dealt with X-rays, and their absorption and secondary emission by solid substances. He showed that secondary emission of X-rays was of two varieties. In one of these the X-rays are scattered, without change of quality. The scattered rays were shown by examining tertiary emission to be polarised, and this was a fundamental result for the classification of X-rays with ordinary radiation, at that time doubtful. Prof. Barkla's other kind of secondary emission is characteristic of the secondary radiator, and is accompanied by selective absorption of the primary rays. He showed that each chemical element emitted more than one definite kind of secondary fluorescent radiation. Concentrating attention on, say, the less penetrating kind, it was found to vary in quality by definite steps with the atomic weight of the secondary radiator.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Romanes lectures, which has been in abeyance for the present year, will, it is hoped, be delivered in the course of 1918. The lecturer appointed by the Vice-Chancellor is the Rt. Hon. H. H. Asquith, D.C.L., honorary fellow of Balliol College. The subject and date are not yet announced.

A BEQUEST of 10,000*l*. has been made to the University of Liverpool by Mrs. A. C. Chaddock for the endowment of a chair of commerce in memory of her husband, unless such a chair has been endowed already, in which case the bequest is to be used for such purposes as the authorities shall determine.

THE provision of excellent laboratories at the Bristol Grammar School was followed in 1915 by the formation of a Scientific Society, which now issues its first report. The society is made up of the science masters and science students, members of the classical side and the upper school being admitted under special rules. The society gives the members special opportunities for developing their school studies along lines of their own choosing, subject to the approval of the master in charge, and work of this character is expected from the members during meeting hours. A strong library has been formed, and the nucleus of a local herbarium, to which the members have contributed 350 species. War difficulties and lighting regulations have somewhat hindered the holding of working meetings, their place being taken by lectures, to which the upper and middle schools were admitted.

AT the Massachusetts Institute of Technology the faculty changes have introduced some new problems, since there has been so much demand by the U.S. Government and by industrial corporations related to the war for men of technical skill. So great has been this draft, says *Science*, that in the department of electrical engineering one-third of the staff has been called away, in mechanical engineering a dozen men have gone into war work, while civil engineering, chemistry, naval architecture, and the other departments have sustained serious losses. On the other hand, the demands for instruction have not only not decreased, for the registration is but slightly less than normal with much the same distribution through courses, but are to a considerable extent greater, for the institute is furnishing instruction on academic and engineering lines to the schools of aeronautics for the Army and Navy, and is carrying on no fewer than three schools for deck officers and the school for marine engineers. Changes already announced include the retirement of Prof. C. R. Cross, with the title of professor emeritus, and the appointment of Prof. E. B. Wilson, of the department of mathematics, to the chair of mathematical physics and head of the department of physics. Prof. C. L. Norton has been appointed professor of industrial physics. In the department of chemical engineering of the University of Michigan all but one member of the faculty have left for active service. Every effort made by the University to replace them temporarily proved unavailing, owing to the unprecedented demand for men in this branch. The situation became so acute that several manufacturing concerns of the State, which employ expert chemical engineers, and the Michigan Agricultural College, came to the aid of the University, and it opened with a complete staff in this department. Dr. C. D. Holley, of the White Lead and Colour Works, of Detroit, will act as head of the department during the absence of Prof. A. H. White.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, November 20.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—J. J. **Joicey** and G. **Talbot**: New South American Rhopalocera, New South American Arctiidæ, new butterflies from Africa and the East, Gynandromorph of *Papilio lycophron*, Hbn., and three aberrations of Lepidoptera.—S. **Alphéraky**: Deformity of *os penis* in a *Phoca caspica*, Nilsson.—Lt.-Col. J. M. **Fawcett**: Notes on a collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–13.—Prof. F. W. **Jones**: The structure of the orbito-temporal region of the skull of Lemur.

Geological Society, November 21.—Dr. Alfred Harker, president, in the chair.—J. **Morrison**: The Shap minor intrusions. The paper deals with the minor igneous intrusions occurring in the triangular area between

Shap, Windermere, and Sedbergh. From their field relations and petrographic characters the intrusions are found to belong to one or the other of two well-marked groups, a division which is regarded as connoting also an age-classification. The rocks of the earlier set, characterised by the presence of large orthoclase-felspars of the granitic type, are intimately associated with the granite, to the immediate neighbourhood of which they are practically confined. The rocks range from quartz-felsites to lamprophyres. Of considerable interest in this group is a series of hybrid intrusions, consisting essentially of rocks of a more or less basic magma enclosing xenocrysts of a more acid (but allied) magma obtained by settlement under intratelluric conditions.

Royal Microscopical Society, November 21.—Mr. E. Heron-Allen, president, in the chair.—E. **Heron-Allen** and A. **Earland**: Variation in the arenaceous rhizopod, *Thurammina papillata*, Brady. The paper was based on a study of many thousands of specimens dredged by the Scottish Fisheries cruiser *Goldseeker* in the North Sea and North Atlantic. The authors regard all hitherto recorded species of Thurammina and Thuraminopsis as varieties of the original type, *T. papillata*, Brady, and as having no biological significance. For taxonomic reasons most of the specific names are retained with varietal values, and certain new varietal names are proposed for forms not previously separated or recorded. The life-history of the genus is for the first time worked out. The paper was illustrated by a number of lantern-slides prepared from direct photographs.

PARIS.

Academy of Sciences, November 12.—M. Camille Jordan in the chair.—E. L. **Bouvier**: The classification of the Parapotamonea, fresh-water crabs of the family of Potamonidæ.—Y. **Delage**: The utilisation of the bathyrheometer for anemometry in cold regions. The instrument, figured and described, has the advantages of giving continuous records of the direction and intensity of the wind, and of working in any climate at any altitude.—M. **Fréchet**: Prolongable functions. —V. **Crémieu**: New experimental researches on gravitation. In an earlier note the question as to whether the Newtonian attraction between two bodies is modified by the relative motion of these bodies was examined experimentally, with negative results. A second series of experiments is now described, in which the results are also negative. The arrangement was such that an alteration of 1 per cent. in the gravitational attraction between the two bodies could have been detected.—M. **Guilleminot**: Quantitative determinations in X-radiotherapy. Choice of the best radiation.—P. **de Sousa**: The eruption of the Algarve coast (Portugal).—M. **Fauchère**: Sericiculture at Madagascar. Races of *Sericaria mori* introduced into Madagascar from Europe, after a period of about two years, give six generations a year instead of one. Contrary to the views usually held, the cocoons produced are not found to be inferior, either in quantity or quality, to the cocoons produced by the original strain. Some precautions found useful in preventing the spread of disease among the silkworms are described.—N. A. **Barbieri**: The laminar optic nerve and ganglionic optic nerve.—E. **Rabaud**: The paralysing instinct of stinging Hymenoptera.—A. **Lécaillon**: The special characters presented by accidental bivoltins (silkworms) at different stages of their development. Races of silkworms producing one generation per annum (univoltin) give occasionally accidental bivoltins. In 1917 377 of the latter type were produced by the author, and the results of the comparison of these with the normal type are given.

November 19.—M. Paul Painlevé in the chair.—G. **Humbert**: The development of irrational quadratics in continued fractions of Stephen Smith.—P. **Appell**: The experiments of M. Carrière on the movement in air of light spherical balls turning round an axis perpendicular to the plane of trajectory.—M. Farlow was elected a correspondant for the section of botany, in succession to the late Julius Wiesner.—W. H. **Young**: The series of polynomials of Legendre.—P. **Humbert**: The reduction of the equation of the critical Jacobians.—H. **Guilleminot**: A new fluorometric apparatus for the estimation of the X-rays. The method proposed is photometric; one-half of a screen is illuminated by a small barium platinocyanide screen receiving the X-rays, the other half of the screen is lit by a standard electric lamp, suitably screened with coloured glasses.—Mlle. E. **Peytral**: The pyrogenous decomposition of methyl alcohol at high temperatures. The quantitative study of the products of decomposition of methyl alcohol at 1150° C. in contact with platinum shows that formaldehyde and hydrogen are the primary products, the aldehyde then giving carbon monoxide and hydrogen.—P. **Russo**: The Djebel Tekzim (Djebilet, western Morocco).—(The late) Mlle. S. **Coëmme**: A new method of reproducing the valves of Ammonites.—C. **Nicolesco**: The application of collodion prints to the reproduction of the valves of Ammonites.—E. **Patte**: Rocks with cup-shaped and pediform cavities in Greek Macedonia. —H. **Arctowski**: Magnetic storms, faculæ, and sunspots.—R. **Souèges**: Embryogeny of the Alismaceæ. Development of the proembryon in *Sagittaria sagittaefolia*.—M. **Mirande**: A new cyanogenetic plant, *Isopyrum fumarioides*.—C. **Matignon** and Mlle. G. **Marchal**: The utilisation of the grape marc as fuel. The dried marc has a calorific value of 4700 calories per gram. The phosphorus and potash can be recovered from the ash, and the fresh marc is more readily air-dried than peat.—L. **Roule**: The relations between the parentage of the salmon (*Salmo salar*) and the European trout (*Salmo trutta*, *Salmo fario*).—J. **Amar**: The absolute resistance of the muscles after atrophy or lesion of the nerves.—W. **Kopaczewski**: Researches on the serum of *Muraena helena*. Molecular equilibrium and toxic power of the serum.—Em. **Bourquelot** and M. **Bridel**: An attempt at the biochemical synthesis of the glucosides of the polyvalent alcohols. The β-diglucoside of glycol.—N. **Fiessinger** and R. **Clogne**: A new ferment of the leucocytes of blood and pus: lipoidase.—Em. **Thiercelin** and C. **Cépède**: Vaccinotherapy and pathological states produced by enterococci.

SYDNEY.

Royal Society of New South Wales, October 3.—Dr. C. **Anderson**: Azurite crystals from the Iodide Mine, Mineral Hill, near Condobolin, N.S. Wales. Fine crystals of azurite (basic oxide of copper) are found in the Iodide Mine, near Condobolin, accompanied by cerussite, cerargyrite, malachite, and cuprite. A total of twenty-one forms, of which one is new, were identified on the crystals, and new elements have been calculated for the mineral.—A. A. **Hamilton**: Notes on topographical, ecological, and taxonomic ocean shoreline vegetation of the Port Jackson District. It is shown that the factor most injurious to plant-life in this region is the on-shore wind, which compresses the shrubs into a stunted horizontal growth and sets up an unstable condition for the beach and dune plants by eroding and transporting the loose sand. The latter adopt various devices to secure a foothold in the mobile soil, trailing, deep tap-rooting, forming a carpet, or framing a network of underground stems. Two indigenous grasses, *Spinifex hirsutus* and *Festuca littoralis*, play an important part in the building and upkeep of the exposed dune embankment, the Fescue

performing the office of pioneer builder and the Spinifex retaining the sand collected by its hardier associate, which ventures out on the beach beyond the limit of other vegetation. The fruits of the beach plants are specially equipped for sea voyaging.—Edna D. **Sayce**: Some determinations of the heat conductivity of selenium. The heat conductivity of selenium has been measured under different conditions, and shows variations similar to, but less marked than, those occurring in the electrical conductivity. In the crystalline (conducting) form the conductivity depends on the temperature of preparation, the age, and the temperature at the time of testing; the conductivity of vitreous selenium varies with the temperature of testing, being independent of the age of the specimen.—Dr. J. B. **Cleland** and E. **Cheel**: Early stage of development of "Dead Man's Finger" (*Lysurus gardneri*). These interesting fungi are developed under the surface of the soil, and only emerge when they are fully matured. The specimens brought under notice were dug out of the ground, and the peculiar structure of certain parts was noted when the egg-like volva burst open to liberate the column or receptacle.

MELBOURNE.

Royal Society of Victoria, August 9.—Mr. F. Wisewould in the chair.—Ellinor **Archer**: An abnormal venous circulation in the frog. The anterior abdominal vein, instead of entering the liver, opened directly into the inferior vena cava. In spite of the absence of any hepatic portal system, the liver was well developed, and the frog healthy and well nourished. Apparently the hepatic portal system is not of primary importance, as in this case all the blood reaching the liver was arterial.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings, vol. iii., No. 7, July).—Teresa **Cohen**: The Cayleyan curve of the quartic.—C. E. **St. John**: A search for an Einstein relativity-gravitational effect in the sun. A series of observations stretching over several years indicates that the Einstein effect does not exist.—L. P. **Eisenhart**: Triads of transformations of conjugate systems of curves.—M. **Gomberg** and C. S. **Schoepfle**: The molecular weights of the triarylmethyls. After discussing factors influencing dissociation and the relation between dissociation and the nature of the aryl groups, seven triphenylmethyls are investigated in detail and various inferences are drawn from the graphs of their dissociations against their concentrations.—F. R. **Lillie**: Sex-determination and sex-differentiation in mammals. Discussion of the results of studies of the anatomy of twenty-two fœtal free-martins, ranging in size from 7·5 to 28 cm. Sex-determination in mammals is not irreversible predestination; with known methods and principles of physiology we can investigate the possible range of reversibility.—A. W. **Hull**: The crystal structure of magnesium. The structure is analysed by means of X-rays.—W. M. **Davis**: The structure of high-standing atolls. Attention is directed to the relation of atoll limestones to their supposed foundation of volcanic rocks. The relative merits of the Glacial-control theory and of Darwin's theory are discussed.—H. **Shapley**: Studies of magnitude in star clusters. VII.—A method for the determination of the relative distances of globular clusters. The median magnitude of short-period variables is constant in each cluster and may be used to determine the distance of the cluster which, with one or two exceptions, is found to be greater than 30,000 light-years.—H. **Raymond**: The principal axes of stellar motion. Three principal axes are determined along which the various groups of stars show markedly unequal motion.—C. D. **Perrine**: Relation of preferential motion and of the spectral-class and magnitude velocity progressions to proper motion.—D. H. **Campbell**: Growth of isolated sporophytes of Anthoceros. The young sporophyte of *Anthoceros pearsoni*, separated from its association with the gametophyte, is capable of limited growth in length, and is able to mature normal spores and elaters from the young sporogenous tissue.—J. W. **Fewkes**: The Mesa Verde types of Pueblos. A morphological study of Far View House and other types of prehistoric buildings.—Margaret C. **Shields**: A determination of the ratio of the specific heats of hydrogen at 18° and −190° C. The value 1·4012, closely in accord with kinetic theory and different from previous determinations at 18° C., is obtained; the value 1·592 is found at −190° C.—W. W. **Coblentz**: Note on the coefficient of total radiation of a uniformly heated enclosure. The value $5{\cdot}722 \times 10^{-12}$ is found by direct measurement, and agrees with that calculated by Millikan on the basis of his values for h and e.—C. E. **St. John** and H. D. **Babcock**: The development of a source for standard wave-lengths and the importance of their fundamental values. It is necessary to examine for pole effect; the problem of wave-length determination is not one of routine, but one for real investigation.—J. J. **Abel** and M. C. **Pincoffs**: The presence of albumoses in extracts of the posterior lobe of the hypophysis cerebri. Secondary albumoses, and possibly peptones, were found to be present in all the therapeutically used extracts of the posterior lobe of the hypophysis cerebri that were examined. The "hypophysin" of the Farbwerke-Höchst is not, as claimed for it, a solution of the isolated active substances of the pituitary gland, but a mixture of albumoses with varying and unknown amounts of active and inactive constituents of the gland.—E. **Uhlenhuth**: The *rôle* of the thymus in the production of tetany. It would seem that thymus contains the substances which cause tetany and secretes them into the body, from which they are removed by the parathyroids. Extirpation of the latter would thus cause tetany.—W. J. **Crozier**: Evidence of assortive mating in a nudibranch. Mating pairs of the nudibranch Chromodoris zebra are found to exhibit a rather high degree of correlation between the sizes of the two members. This is due to assortive mating, which may constitute an important influence tending to increase the numbers of larvæ.—A. G. **Mayer**: Coral reefs of Tutuila, with reference to the Murray-Agassiz solution theory.

PETROGRAD.

Academy of Sciences, May 10.—Ja. S. **Bezikovič**: Magnetic observations at fifty-four points of the Government of Bessarabia in 1914.—V. N. **Liubimenko**: Medicinal plants of the Government of Taurida.—V. I. **Iskiul**: Investigation of the fire-resisting clays of the Tichvinskij district of the Government of Novgorod.—P. **Eskol**: Mineralogical observations in the Government of Olonetz in the summer of 1916.—N. M. **Abramov** and P. N. **Čirvinskij**: The puzzolanes of the south of Russia.—P. A. **Borisov**: Crystals of silicates from the dolomites of the Povenc district.—K. A. **Nenadkevič** and V. I. **Vernadskij**: The hydrogen sulphide in limestones and dolomites.—V. M. **Rylov**: *Heterocope soldatovi*, a new species of fresh-water Crustacea (Eucopepoda, fam. Centropagidæ).—V. I. **Palladin** and Miss E. R. **Hubbenet**: The absorption of the ultra-violet rays by plants.—O. A. **Walther**: The diastatic splitting of arginine in the yellow lupin.

May 24.—A. S. **Famincyn**: A new method for the culture of micro-organisms.—A. S. **Vasiljev**: Proof of the ellipsoidal form and of the tides of the terrestrial atmosphere. Influence of these factors on the zenithal distances of the stars.—N. A. **Kulik**: The Upper Creta-

ceous of the Pečora region.—P. Zemiatčenskij: The absorbent properties of Russian clays.—K. K. Matveev: Radio-active minerals of the Borščovok range.—Ja. V. Samojlov and A. G. Titov: Ferro-magnesian concretions from the beds of the Black Sea, the Baltic, and the Barents Sea.

BOOKS RECEIVED.

The Life of Sir Clements R. Markham, K.C.B., F.R.S. By Admiral Sir A. H. Markham. Pp. xi+384. (London: J. Murray.) 15*s.* net.

The Life of Sir Colin C. Scott-Moncrieff. Edited by Mary A. Hollings. Pp. xii+374. (London: J. Murray.) 12*s.* net.

Adolescence. By S. Paget. Pp. 59. (London: Constable and Co., Ltd.) 7*d.* net.

The Human Body. By Prof. H. N. Martin. Tenth edition, revised by Prof. E. G. Martin. Pp. xviii+649. (New York: H. Holt and Co.)

The Wheat Problem. By Sir W. Crookes. Third edition, with Preface, and Additional Chapter, bringing the Statistical Information up to date, and a Chapter on Future Wheat Supplies, by Sir R. H. Rew. Pp. xvi+100. (London: Longmans and Co.) 3*s.* 6*d.* net.

The American Indian. By C. Wissler. Pp. xiii+435. (New York: D. C. McMurtrie.)

The Self and Nature. By Prof. De Witt H. Parker. Pp. ix+316. (Cambridge, Mass.: Harvard University Press; London: H. Milford.) 8*s.* 6*d.* net.

Notions Fondamentales de Chimie Organique. By Prof. C. Mouren. Fifth edition. Pp. 548. (Paris: Gauthier-Villars et Cie.) 20 francs.

The Chemical Constitution of the Proteins. By Dr. R. H. A. Plimmer. In three parts. Part i., Analysis. Third edition. Pp. xii+174. (London: Longmans and Co.) 6*s.* net.

Treatise on Applied Analytical Chemistry. By Prof. V. Villavecchia and others. Translated by T. H. Pope. Vol. i. Pp. xvi+475. (London: J. and A. Churchill.) 21*s.* net.

Quantitative Chemical Analysis. By Prof. F. Clowes and J. B. Coleman. Eleventh edition. Pp. xxiv+580. (London: J. and A. Churchill.) 12*s.* 6*d.* net.

Therapeutic Immunisation. By Dr. W. M. Crofton. Pp. 224. (London: J. and A. Churchill.) 7*s.* 6*d.* net.

Reagents and Reactions. By Prof. E. Tognoli. Translated by C. A. Mitchell. Pp. viii+228. (London: J. and A. Churchill.) 6*s.* net.

Locke's Theory of Knowledge and its Historical Relations. By Prof. J. Gibson. Pp. xiv+338. (Cambridge: At the University Press.) 10*s.* 6*d.* net.

The Problem of Creation. By the Rt. Rev. J. E. Mercer. Pp. xiii+325. (London: S.P.C.K.) 7*s.* 6*d.* net.

The Vegetable Garden. By E. J. S. Lay. Pp. 144. (London: Macmillan and Co., Ltd.) 1*s.* 6*d.*

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 6.

ROYAL SOCIETY, at 4.30.—The Series of Legendre: Prof. W. H. Young.—The Discharge of Gases under High Pressures: L. Hartshorn.—Internal Ballistics: Lieut.-Col. A. G. Hadcock.—The Electrostatic Problem of a Conducting Sphere in a Spherical Cavity: Dr. Alex. Russell.—The Zeroes of Bessel Functions: Prof. G. N. Watson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Electrical Cooking as applied to Large Kitchens: W. A. Gillott.

CHEMICAL SOCIETY, at 8.—The Relation between Chemical Constitution and Physiological Action: Dr. F. L. Pyman.

MATHEMATICAL SOCIETY at 5.—A New Method of describing a Three-bar Curve: Col. R. L. Hippisley.—Proof of the Primality of $N=\frac{1}{9}(10^{19}-1)$: Oscar Hoppe.—New Tauberian Theorems: Messrs. Hardy and Littlewood.—The Curves which lie on the Quartic Surface in Space of Four Dimensions and the corresponding Curves on the Cubic Surface and the Quartic with a Double Conic: C. V. Hanumanta Rao.—(1) The connection between Legendre Series and Fourier Series; (2) Series of Bessel Functions: Prof. W. H. Young.

MONDAY, DECEMBER 10.

ROYAL SOCIETY OF ARTS, at 4.30.—Progress in the Metallurgy of Copper: Prof. H. C. H. Carpenter.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Future of Siberia and her Neighbours: Col. Harold Swayne.

WEDNESDAY, DECEMBER 12.

ROYAL SOCIETY OF ARTS, at 4.30.—Technical Training for Disabled Soldiers and Sailors: Lord Charnwood.

FARADAY SOCIETY, at 7.30.—Annual General Meeting.—At 8.—A Study of the Refractivities of Saturated and Unsaturated Compounds. I. and II.: Gervaise Le Bas.—The Thermal Properties of Sulphuric Acid and Oleum: Dr. Alfred W. Porter.—Iso-piestic Solutions: W. R. Bousfield, K.C.

THURSDAY, DECEMBER 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Formation of Nitrites from Nitrates in Aqueous Solution by the Action of Sunlight and the Assimilation of the Nitrites by Green Leaves in Sunlight: B. Moore.—The Transition from Rostro-carinate Flint Implements to the Tongue-shaped Implements of River-terrace Gravels: J. R. Moir.

LINNEAN SOCIETY, at 5.—Seeds with a Stony Endocarp and their Germination: A. W. Hill.—*Inter se* Experiments in Pheasant Crossing in evidence of Mendel's Law: Mrs. R. Haig Thomas.

ROYAL SOCIETY OF ARTS, at 4.30.—The Trade of India with Russia, France, and Italy: D. T. Chadwick.

OPTICAL SOCIETY, at 8.—Proposed Standard Optical Notation and Sign Convention: J. W. French.—Optical Nomenclature and Symbolism: T. Smith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on the Metric System. Introductory Papers by L. B. Atkinson and A. J. Stubbs.

FRIDAY, DECEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—The Use of Soap Films in Solving Torsion Problems: A. A. Griffith and G. I. Taylor.

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THURSDAY, DECEMBER 13, 1917.

GOLD-BEARING CONGLOMERATES OF SOUTH AFRICA.

The Banket: a Study of the Auriferous Conglomerates of the Witwatersrand and the Associated Rocks. By Prof. R. B. Young. Pp. xv + 125. (London: Gurney and Jackson, 1917.) Price 8s. 6d. net.

THE British Empire is not uniformly fortunate in its natural resources of the useful and precious metals. The ore-supplies of some of these, *e.g.* copper, aluminium, platinum, and mercury, as at present proved, are either deficient or entirely wanting. In such cases partial or complete dependence upon foreign sources is unavoidable, unless and until greater supplies are discovered. In other cases, although the known ore-resources are plentiful, the domestic output of metal has hitherto been inadequate owing to a deplorable lack of metallurgical enterprise within the Empire—raw materials, or partly smelted products, of British origin being exported to foreign countries and reduced to metal by foreign skill and labour. Zinc, lead, nickel, and until recently tungsten, may be cited as notorious examples, and for supplies of these metals British consumers have been placed in an unwarrantable position of insecurity. In a few cases, however, *e.g.* tin and gold, not only are the ores abundant, but they are smelted entirely within the Empire, and furnish metal sufficient, in normal times, both for Imperial consumption and for export. Cases of this kind should and could be more numerous, and that they will be, in the future, is already indicated by the birth and remarkable growth of a British tungsten industry since the inception of the war, and by the steps that are now being taken to ensure a greatly augmented Imperial production of nickel, zinc, lead, and iron.

In its gold resources the Empire is particularly fortunate. Of the world's current yearly output of 720,000 kilos. of new gold, 450,000 kilos., or more than 62 per cent., are of British origin. Of this amount 283,000 kilos., or 63 per cent. of the British production and 39 per cent. of the world's, are derived from the Transvaal. The remarkable "reefs" of conglomerate or "banket," from which the gold of the Witwatersrand is obtained, possess, therefore, a unique economic importance. They have a considerable scientific interest also, and it is with this aspect of them that Prof. Young deals in the publication now under review. The book summarises the results of researches which have been made by many investigators during the thirty years of gold-mining activity on the Rand. The information it contains is already familiar to many mining geologists, but has not hitherto been available in the pages of a single small volume, and in this conveniently epitomised form it will be widely welcomed.

The subject-matter is presented in five chapters. In the first the geology of the auriferous region of South Africa is briefly described, attention being confined to the Swaziland, Witwatersrand, and Transvaal Systems, in which alone gold-occurrences of economic importance have been found. The most important of these, the Witwatersrand System, with its three highly productive "banket reefs," is shown to be a complex of sedimentary rocks, derived from the waste of the underlying Swaziland System, and of igneous rocks intruded into them in the form of dykes and sills.

In the second chapter the author deals with the original constituents of the gold-bearing conglomerates. Among the pebbles, vein-quartz almost exclusively preponderates over quartzite, quartz porphyry, schist, and other rocks. In the sandy matrix also quartz is in large excess over the other minerals recorded—zircon, tourmaline, chromite, diamond, iridosmine, etc.—which occur only in minute proportions. The remarkable absence of magnetite and ilmenite grains is believed to be due to their replacement by pyrite and other substances. The iridosmine, the genesis of which has been much debated, is shown conclusively to be a detrital constituent, and, with the chromite which so often accompanies it, is attributed to the disintegration of ultra-basic igneous rocks of the Swaziland System. It is of interest to note that in modern alluvials which carry this mineral detrital gold is invariably found with it, and the fact that in these ancient pebble-beds also gold accompanies it—although not in the alluvial condition—is one that must be borne in mind when the genesis of the gold in the "banket" is being considered.

In the third chapter the secondary minerals the "banket" are described. These are especially numerous, and include quartz, chloritoid, chlorite, sericite, tourmaline, rutile, anatase, calcite, dolomite, carbon, pyrite, and gold. Several of them are strongly suggestive of hydrothermal action, and are doubtless rightly ascribed to the operation of magmatic waters emanating from the igneous intrusions. Particularly interesting are the carbon and pyrite, and the vexed question of their origin is discussed at some length. The rounded forms often shown by them, which have caused them to be regarded as original constituents, are referred to concretionary growth and to the pseudomorphous replacement of water-worn pebbles or grains. The gold never shows detrital form, its boundaries being either crystalline or very irregular. Moreover, it is often so intimately associated with certain of these undoubtedly secondary minerals, especially the two just mentioned, that in its present condition, at any rate, a secondary origin must be ascribed to it.

The fourth chapter deals with the sedimentary and igneous rocks with which the "bankets" are associated. Secondary mineralisation is shown to have affected not only the gold-bearing conglomerates, but also the sediments in which they are enclosed, and in many cases a definite connection can be established between this mineralisation and the igneous intrusions.

The concluding chapter is devoted to the geological history of the "banket" and to the much-discussed question of the mode of origin of its gold. The original deposition of the conglomerates has been variously assigned to lacustrine, fluviatile, deltaic, and marine agencies. A marine origin has been most generally favoured, and is here supported. With regard to the genesis of the gold, the well-known "placer," "infiltration," and "precipitation" theories are outlined. The last, in agreement with prevailing opinion, is regarded as untenable. The author, at one time an advocate of the second theory, is now led to adopt that modification of the first to which so many who have followed the controversy have been attracted of late years, viz. that the "bankets" are ancient and highly modified "placers" in which the originally detrital gold has been dissolved by high-temperature solutions and redeposited. This has entailed the loss of its detrital form, and the assumption of the crystallised state and the association with secondary minerals which it now exhibits. There is much to be said for this view, since it reconciles the facts which point to a "placer" origin with those which prove deposition from solution, and from which "infiltration" of the gold from outside has been erroneously inferred.

The author is to be congratulated upon his remarkably fine series of illustrations. The collection and preparation of the material for these must have involved the expenditure of much time and labour. They add greatly to the value and interest of the volume.

C. G. C.

MUNICIPAL ENGINEERING.

Municipal Engineering Practice. By A. Prescott Folwell. Pp. xi+422. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 16s. 6d. net.

THE author defines the purpose of municipal engineering to be the planning, constructing, and maintaining of the publicly owned features and utilities of a city. He points out that its practice must conform to natural laws and legal enactments. A municipal engineer, therefore, should be acquainted with various branches of science and engineering. There is not much reference to scientific principles in this treatise; it is mainly a clear and interesting descriptive account of the methods and devices of city engineering, and that entirely from an American point of view. The large subjects of water supply, sewerage, and street-paving are fully dealt with in other text-books, and are omitted or slightly discussed, but the author thinks that information as to street cleansing, comfort stations, and similar matters is not readily available, and that city planning, street lighting, etc., require treating from the point of view of the taxpayer and the city engineer.

Methods of estimating and forecasting population are described, and some striking statistics are given of the growth of American cities. In a chapter on town-planning, the chequer-board, ring, and radiating systems of streets are examined, and an account is given of broad roads divided for automobile, truck, and street railway services. As might be expected, the construction of streets in the States is often less satisfactory than here. For instance, in St. Paul there are 321 miles of plank footways, which have a life of only three to six years. It is significant that judgment suits for accidents occurring on them cost the city nearly 3*l*. per mile per annum. Concrete footways are now most generally adopted with concrete kerbs.

There is a good chapter on surveys in cities, which are very systematically carried out in America, and plotted records of all the surface and sub-surface structures are preserved. In some cities a large use is made of photographic records, one purpose being to preserve records which may be valuable in future lawsuits. Sprinkling macadam or gravel roads with oil once to three times a season is a practice said to have become quite general, but we think is unknown here except in the different form of tar spraying. The oil is said to be distributed by an ordinary water-sprinkling cart. The disposal of city waste and the laying out of parks and planting shade trees are amongst other subjects described.

A MANUAL ON EXPLOSIVES.

A Short Account of Explosives. By A. Marshall. Pp. viii+96. (London: J. and A. Churchill, 1917.) Price 5s. net.

THE two volumes comprising the second edition of Mr. Marshall's treatise on explosives have been recently reviewed in these columns, and the present small book consists of a condensation of parts of the larger treatise in order "to present in a clear and simple manner the main facts concerning explosives and their properties."

After a short introductory chapter, the author deals in the succeeding six chapters with the preparation and properties of black powder and similar mixtures, nitrocellulose, nitroglycerine, military and commercial high explosives, and smokeless powders. Another chapter is given to fireworks, and the remaining three chapters to the properties of explosives, ignition and detonation, and precautions to be taken in the manufacture, handling, and storage of explosives.

Referring to the large Congreve war-rocket of 24 lb. weight, which was used with good effect at Copenhagen, Walcheren, and Leipzig, Mr. Marshall expresses the opinion that the future may see its use revived. Its great defect is stated to be want of accuracy, but an obvious disadvantage is that rockets carry their own propulsive charge, so that for a given destructiveness they have to be relatively very heavy. Trials have been made by the Germans in the present war, but rockets are unable to compete with guns, howitzers, and trench mortars.

In his concluding pages Mr. Marshall deals

briefly with the poisonous properties of certain explosives, and thus in the smaller volume meets one of the few points of criticism in the review of his large treatise. He says that in the case of trotyl (T.N.T.) it is apparently that absorbed through the skin which is especially injurious; it passes in a combined form into the blood, and in some cases is eliminated from the system only very slowly. Hence the necessity for scrupulous attention to cleanliness.

Mr. Marshall has produced a very readable and interesting synopsis, and his small volume will undoubtedly prove of considerable service to those who require only an outline of the subject in connection with their work, and of interest to the general reader who wishes to enlarge his store of useful knowledge in a subject of such present-day interest.

OUR BOOKSHELF.

The Discovery of America, 1492–1584. Edited by P. F. Alexander. (Cambridge Travel Books.) Pp. xviii+212. (Cambridge: At the University Press, 1917.) Price 3*s.* net.

THIS volume is one of a series which aims at illustrating the history of geographical discovery by means of selected voyages and travels. The books are intended for use as school readers as aids in the teaching of geography. With this end in view, spelling and punctuation have been modernised, though archaic words have been kept. A list of some dates in the history of geographical discovery and a few notes have been added. The present volume contains the first three voyages of Columbus, Sir Humphrey Gilbert's voyage of 1583, the voyage of Amadas and Barlow to Virginia in 1584, and Jacques Cartier's voyage to the St. Lawrence. There are a number of illustrations reproduced from old prints and woodcuts, and a few useful sketch maps. So far as the plan of the series goes, the present volume is well executed, but it is a little difficult to see what place such a book can find in the school curriculum. The English and style are scarcely suitable for the teaching of reading, while the geographical knowledge to be derived from the voyages is not sufficient to warrant the use of the volume as a text-book in geography. The limited time devoted to geography in most schools could be more profitably utilised. We trust, however, that some use may be found for the series.

Foods and their Relative Nourishing Value. By Prof. W. H. Thompson. Second edition. Pp. 38. (Dublin: At the University Press, 1917.) Price 4*d.* net.

IF the British public has not acquired by the end of the war the art of adjusting its diet on rational and scientifically correct lines, it will not be for lack of sound instruction and good advice. There are no very definite external signs as yet of any widespread reform in this direction in the feeding habits of the mass of the people, but the popularity of food literature is evidence at least that large numbers of people are desirous of acquiring information as to the possibilities of securing economy in food consumption without sacrifice of efficiency. Much of this literature is of the empirical cookery-book type and can scarcely survive the period of food stringency, but it is gratifying to find that a ready sale can be found for the more select and permanently useful literature in which the scientific principles which must underlie food economy are expounded for the benefit of the layman.

There are more pretentious works than, but none which gives as good value for the money as, this booklet by Prof. Thompson, which now appears in a revised, second edition. All the essential information is conveyed in its few pages in concise, lucid form, and is supplemented by a considerable range of diagrammatic and other illustrative matter. The modern views as to the essentials of adequate nutrition are clearly presented without the use of technical terms beyond the "protein" and "Calorie" which are fast acquiring a place in the popular vocabulary. The booklet is supplied to the public at the net cost of issue, and Prof. Thompson is to be congratulated upon the response which his generosity has already achieved.

A Rumanian Diary, 1915, 1916, 1917. By Lady Kennard. Pp. vii+191. (London: William Heinemann, 1917.) Price 5*s.* net.

THIS small volume is nothing more than it claims to be, a diary of life in Bukarest and Jassy before and after Rumania's entry into the war. It touches a phase of the war about which little has been heard in this country. Whatever merits it has are due to its vivid descriptions of conditions in Rumania, written from day to day when anxiety and hope, uncertainty and despair were the daily lot of the author. We gather that most of the diary was written by Lady Kennard, but that after she left Rumania she drew on letters from her friends to complete the story. There are no new facts in the book, but it should be read by anyone who wishes to realise what the intervention of Rumania cost that unhappy country and to what a sad plight she was reduced by the enemy invasion. The volume is illustrated by a few photographs.

How to Collect and Dry Flowering Plants and Ferns. By H. S. Thompson. Pp. 56. (London: G. Routledge and Sons, Ltd., 1917.) Price 7*d.* net.

THESE practical hints on collecting, drying, and mounting plants will prove of real service to young botanists. The author recognises the improvement in the teaching of botany which has taken place in recent years, especially in secondary schools, and realises the importance of basing instruction, where possible, upon living specimens; but he makes out a good case for the herbarium, and we hope his booklet will meet with the success it deserves.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Resonance Radiation and the Quantum Theory.

IN the *Philosophical Magazine* for September, 1916, Dr. Silberstein has made an attempt to explain the resonance radiation of iodine vapour on the basis of classical dynamics by assuming that the resonator is non-Hookean—*i.e.* that its restitutive elastic force is not simply proportional to the displacement. On this theory, the principal lines in the resonance series should appear at constant frequency-intervals, and to support this view Dr. Silberstein has given a tabular statement of the frequencies and their differences, based upon the work of Prof. R. W. Wood. A critical examination of the figures shows, however, that the frequency-intervals are by no means constant, but have a decided tendency to decrease on the long wave-length side. This has, indeed, been remarked upon by Prof. Wood himself (*Phil. Mag.*, October, 1912). I find on calculation that it is *not* the frequencies themselves, but *their square-roots*, that show constant decrements in the series. The following table, prepared from Prof. Wood's data (*loc. cit.*, p. 684) for the mercury green line excitation, demonstrates this clearly:—

Serial No. n	Frequencies ν_n $10^{10}\times$	$\frac{\nu_0-\nu_n}{n}$ $10^{10}\times$	$\frac{\nu_0^{1/2}-\nu_n^{1/2}}{n}$ $10^{3}\times$
0	54937·5	—	—
1	54279·0	658·5	141·0
2	53646·9	645·3	138·5
3	53013·0	641·5	137·0
4	52386·0	637·8	137·7
5	51759·0	635·7	137·6
6	51144·0	632·3	137·8
7	50523·0	630·7	137·4
8	49911·0	628·2	137·3
9	—	—	—
10	48696·0	624·1	137·2
11	48096·0	621·9	137·1
12	47493·0	620·4	137·2
13	46902·0	618·1	137·2
14	—	—	—
15	45726·0	614·1	137·1
16	45147·0	611·9	137·0
17	44562·0	610·3	137·1
18	43983·0	608·6	137·4
19	43419·0	606·2	136·9
20	42855·0	604·1	136·9

The constancy of the figures in the last column over twenty lines seems altogether too striking to be accidental, and rather suggests an analogy with Moseley's law for the high-frequency spectra of the elements, according to which the square-roots of the frequencies of the K and L characteristic radiations increase by equal steps with the atomic number of the element—that is, on Sir E. Rutherford's theory, with the charge on the nucleus. If, in the same element, we imagine a configuration (permanent or quasi-stable) of the atom, in which the electrons revolve in successive concentric rings, the effect of the nucleus and all the other electrons on any one electron may be approximately represented by a single nucleus of proper equivalent charge; and a mechanism in which this equivalent charge, corresponding with the successive electrons in the atom, varies by successive equal steps would, on the quantum theory, exhibit the phenomena of resonance radiation, as in the case of iodine vapour. It seems possible that this idea may find application in the fuller development of Bohr's theory of spectral series.

T. K. CHINMAYAM.

210 Bow-Bazar Street, Calcutta, October 15.

An Optical Phenomenon.

IN addition to the accounts in NATURE referred to by Mr. J. W. Giltay in your issue of November 22, the phenomenon mentioned by me in NATURE of October 18 had previously been far more fully described by Dr. John Aitken in a paper "On a New Variety of Ocular Spectrum" in the *Journal of Anatomy and Physiology*, vol. xiii., p. 322; and, as stated in this paper, the phenomenon noticed by Mr. C. Carus Wilson (NATURE, October 25), when travelling by train in a rear coupé compartment, was described by Prof. Silvanus Thompson in the report of the British Association for 1877. Dr. Aitken experimented with rotating discs divided into about twenty-four sectors, white and black alternately, and with endless bands of paper with black bars painted across them. A convenient way of viewing the apparent motion was to look at a sheet of mottled paper, after looking at the rotating disc or moving band, when the markings on the paper appeared to move in a contrary direction to the exciting impression. Though some of the mottlings seem to flow past the others, it was found by Dr. Aitken that a straight line drawn across "the spectral stream" did not appear to be bent, as one might have supposed would be the case. If, after viewing the rotating disc, another similar disc or the drawing of a wheel is looked at, the second disc or the wheel appears to rotate in a contrary direction to the first; but if the second disc is larger than the first, or the spokes of the wheel are extended to a greater size than the rotating disc, "this extension will entirely destroy all appearance of rotation, and the wheel will appear at rest. Do not these last experiments suggest that the seat of illusion is deeper than the retina?"

C. J. P. CAVE.

December 3.

THE CONTROL OF THE NON-FERROUS METAL INDUSTRIES.

BEFORE the war the world's markets for the majority of the non-ferrous metals were very largely controlled by a group of German metal companies engaged primarily in buying metals and acting as selling agents for producers. How complete this control was few people knew. The outbreak of war disclosed it in all its formidableness. The most important of these concerns was the Metallgesellschaft of Frankfort-on-the-Main. This place was the centre of certain German financial interests which had combined to establish the Metall Bank and the Metallurgische Gesellschaft. In one way or another this great organisation had established financial interests in metal undertakings, not only in Germany and Austria, but also in the U.S.A., the United Kingdom, and various parts of the British Empire.

This enormously powerful group of companies controlled the world's metal markets, of which Frankfort became the centre. Their connections with other undertakings and their ramifications were exceedingly complicated and difficult to control. In some instances there was a direct financial connection; in others the connection was

established by some form of agreement. But whatever the method there was no doubt about the ascendancy acquired by the Germans. The case of lead may be cited as an example. Before the war the Germans were, by means of the so-called Lead Convention, which they organised, placed in complete control of the lead trade of the world. Attempts were also being made to secure the control of all the free lead of the world. As regards zinc the position has already been described in the columns of NATURE (October 19, 1916). At the outbreak of war this control was a source of great embarrassment to the Government, and for quite two years afterwards the cause of this country and its Allies was severely handicapped because we were without the necessary metal supplies, and many trades [illegible] in jeopardy. Had not the U.S.A. come to the rescue in supplying these deficiencies, particularly as regards copper, zinc, and lead, it is very doubtful whether the Allies would have been able to avoid defeat.

In order to obtain the best expert advice on the problem of how to meet this difficulty in the future, the late President of the Board of Trade appointed a strong committee composed of representatives of this country, and to this Sir Albert Stanley, the present occupant of the position, added three members representing respectively Canada, Australia, and South Africa. According to the statement made by him in moving the second reading of the "Non-ferrous Metal Industry Bill" in the House of Commons on December 3, the Committee came to the conclusion that an essential preliminary condition of the successful organisation of any counter-measure was to secure, at all events for a period after the war, that all trace of German influence and association—direct or indirect—should be eliminated from any undertaking allowed to do business *in* this country. The Bill aims at achieving this object.

Clause 1 provides that it is unlawful to deal in certain metals and ores without a licence. The licences to be granted are renewable annually. Clause 2 gives the Board of Trade power to require certain information and to inspect the books and documents of persons or firms who apply for, or obtain, licences. Clause 3 provides for certain penalties for contravention of the Act. Clause 4 empowers the Board of Trade to make rules for carrying out the Act, and Clause 5 specifies the metals and ores to which the Act applies. The Act is intended to be in force during the war and for five years after its termination. The President of the Board of Trade stated that the measure is designed, not in the interest of "the trade," but in that of the nation, and that the control of metals which are so essential to the development of British industries must not be allowed to fall again into German hands after the war. He also claimed that the power of control given by the Bill will be a distinct step towards securing our economic freedom.

The discussion took a somewhat curious course. The rejection of the Bill was moved by Mr. J. M. Henderson, but his amendment was not seconded, and, therefore, was not put from the chair. Later the rejection was moved by Sir F. Banbury, and this was seconded. Finally, the debate stood adjourned. The discussion was resumed on Tuesday, December 11, when, in a division on the amendment that the Bill be rejected, there voted against the rejection 182, and for it 79, giving a majority of 103 against rejection. The result was that the Bill was read a second time.

H. C. H. CARPENTER.

THE RÔLE OF SELECTION IN EVOLUTION.[1]

ABOUT the beginning of the twentieth century the current of doubt as to the evolutionary importance of processes of selection grew rapidly in strength, and swept not a few naturalists off their feet. Bateson and De Vries produced evidence of the frequent occurrence of discontinuous variations or mutations; De Vries began methodical testings of what selection could do in the course of years with maize, buttercups, striped flowers, and four-leaved clover—the general outcome being that it did not do very much; and Johannsen, working carefully on "pure lines" of beans, which are self-fertilising but show fluctuating variation in the size of the seed, proved that selection continued generation after generation in a particular direction may be without result, so far as any change in average seed size is concerned. These and other considerations led to a depreciation of the importance of selection processes. As Prof. W. E. Castle says in a very interesting pronouncement:—

> In the minds of many biologists at the present time selection is an obsolete agency in evolution, and an adequate explanation of evolution is to be found only in mutation and pure lines. I believe this to be a mistaken view, not because mutation and pure lines are false, but because their applicability is very limited compared with the broad field of organic evolution. To universalise them is to hide the world by holding a small object close to the eye.

As De Vries has always insisted, mutations come we know not how, but selection determines which must go and which will stay. According to Darwin, new types are for the most part established gradually; according to De Vries, they arise abruptly. According to Darwin, new types are, for the most part plastic; according to De Vries, new types are fully stable. According to Darwin, one evolutionary change follows upon, and is made possible by, another; according to De Vries, one evolutionary change has no necessary relation to another. According to Darwin, natural selection determines what classes of variations shall survive, and, in consequence, what shall be the variable material subjected to selection in the next generation; according to De Vries, natural selection determines only what classes of variations shall survive, and exercises no influence on the subsequent variability of the race. According to Darwin, the further evolution of our

[1] Journ. Washington Acad. Sci., vii. (1917), No. 12, pp. 369-87.

domestic animals and cultivated plants (and of man himself) is to some extent controllable, because we can by selection influence the variability of later generations; according to De Vries, evolution is beyond our control except as we discover and isolate variations. Thus does Prof. Castle contrast the two sets of views, which "remind us somewhat of the theological ideas of free-will and predestination respectively." But which view is right?

The evidence from palæontology, geographical distribution, and classification tends on the whole in favour of the Darwinian view that "evolution as an age-long process has been gradual and progressive, not abrupt and unguided," but the evidence from experimental breeding leans to either side. The mutationists hold that selection "can do nothing but isolate variations which may sporadically put in an appearance or which may by hybridisation be brought together into new combinations." The selectionists, with whom Prof. Castle ranks himself, maintain that selection "can accomplish more than the mere isolation of variations, because it can, by a series of selections, influence further variability." How is one to decide?

Prof. Castle considers carefully the attempts that have been made to generalise Johannsen's brilliant discovery of the principle of "pure lines," and shows that this is not warranted. In the case of certain characters in guinea-pigs he has himself found that a *ne plus ultra* is reached which cannot be changed by selection in an inbred race. "Thus a very dark form of Himalayan albino, after a certain amount of improvement by selection, could not be further darkened to any appreciable extent." On the other hand, certain characters of guinea-pigs, rabbits, and rats have been found to respond readily to selection in a particular direction. Prof. Castle's experiment with hooded rats "selected simultaneously in *plus* and *minus* directions has produced one race which is black all over except a white patch of variable size underneath, and another race which is white all over except for the top of the head and the back of the neck, which are black. The races do not overlap at all, and have not done so for many generations, though they still continue to diverge from each other as a result of continued selection."

It comes to this, that divergent conclusions are in part due to the data utilised.

"A study of albinism alone would lead one to believe in the fixity and constancy of Mendelian genes and the impossibility of modifying them by selection." But "in the case of such characters as white spotting in mammals, it is evident that a change in the mean of the character in a particular direction in consequence of selection actually displaces in the direction of selection the centre of gravity of variation, so that in a very true sense selection makes possible further variation in that same direction."

Selection cannot start new lines of variation, but it can continue and extend variation already initiated.

J. A. T.

THE FUTURE OF THE TRADE IN COLONIAL RAW MATERIALS.

It is now well known that before the war large quantities of raw materials produced in the British Colonies found their way in the first instance to Germany, where they were converted into manufactured products, of which considerable quantities were then exported from Germany to this country and other parts of the Empire. Most people are now of opinion that this indirect method of trading should not be resumed after the war, and that these intermediate processes of manufacture should be carried on in this country, or at least within the Empire. It has also become clear, especially in the last few months, that immediately after the war there will be great competition among all the manufacturing countries for supplies of raw materials, and probably most people in the Allied countries, who realise that the Allies effectively control the bulk of the world's supplies of such materials, are of opinion that the Allies should utilise this advantage to meet their own requirements first.

There can be little doubt as to the trend of public opinion on these points, but it is not at all clear what action, if any, is being taken to give effect to it, except in the one case of West African oil-seeds, which was investigated by a special committee appointed by the Colonial Office in 1915. That committee recommended the imposition of an export duty on palm kernels exported from British West Africa to be crushed in countries outside the Empire, and this recommendation was adopted by the Secretary of State for the Colonies, with the result that the palm-kernel crushing industry established in this country since the war is likely to remain here in future. The publication of the results of the British committee's investigations has apparently stimulated the Colonial Institute at Marseilles into conducting similar inquiries into the sources of supply of the raw materials which form the basis of two of the chief industries carried on in Marseilles, namely, oil-seeds and cereals.

Committees have been appointed by the Marseilles Colonial Institute to investigate these two groups of raw materials, and the Oil-seeds Committee has already published two special bulletins. The first of these contains the report (in French) of the British West African Oil-seeds Committee, and the second gives a *résumé* of some of the evidence taken by that committee, a translation of a portion of the Imperial Institute monograph on oil-seeds and feeding-cakes (Murray, 1915), and some preliminary information regarding the work of the French committee. The latter is first taking up questions connected with the trade in ground nuts, the most important oil-seed crushed in Marseilles; and the bulletin contains evidence for and against the decortication of ground nuts before shipment, a matter of first-rate importance in connection with the ground-nut trade of India. Hitherto, it has been held that ground-nut oil of edible quality cannot

be made from ground nuts shelled in the country of production and exported in the form of kernels, the argument being that the oil in such kernels must always contain too much free fatty acid. It is clear from the French bulletin, however, that lack of tonnage, if nothing else, is now forcing French oil-seed crushers to reconsider this question and to find means of importing ground-nut kernels in good condition.

In a recent number (No. 86 of 1917) of *L'Expansion Coloniale* M. Emile Baillaud, to whose activity the Marseilles Colonial Institute owes much of its prestige in France, discusses the problems which these French committees on cereals and oil-seeds will take into consideration. From this it appears that the committees are faced with much the same problems as those mentioned in the first paragraph of this article, viz. that French, like British, manufacturers have not been able to take up new oil-seeds, but have largely left the initiative in such matters to Germany, and that they have not utilised and developed sources of supply in their own colonies. It will be the chief object of the committees to ascertain how this state of things can be remedied. It is interesting in this connection to note that M. Baillaud has a proper appreciation of the necessity for technical investigations, and suggests that the Committee on Oil-seeds will require to initiate investigations similar to those carried on for some years past on the oil-palm by the Imperial Institute in this country in co-operation with the Departments of Agriculture in British West Africa.

NOTES.

As an outcome of the Departmental Committee on the Welfare of the Blind, which recently issued an excellent report, the President of the Local Government Board (Mr. W. Hayes Fisher) has appointed a Committee to advise the department on matters relating to the care and supervision of the blind. The selection of members appears to have been made with discretion, except that, as pointed out by "Ophthalmic Surgeon" in a letter to the *Times* of December 8, there is no medical man or ophthalmic surgeon upon the Committee. The original Committee had an ophthalmic surgeon among its number, and applied to the Royal Society of Medicine for assistance in its deliberations. A Sub-Committee of the Ophthalmological Section was appointed, and devoted much time and trouble to the subject. The report shows that it afforded very material help. Mr. Hayes Fisher, writing to the *Times* of December 11, excuses himself for the absence of any medical representation on the Advisory Committee by saying that "nine-tenths of the Committee's time will be taken up with the consideration of administrative problems," and that "under existing circumstances it would not be right to make a further demand upon the time of any of our eminent ophthalmic specialists, who are already so fully occupied." The courteous terms in which this letter is couched will doubtless be appreciated by the Royal Society of Medicine and the medical profession generally, but they do not succeed in masking the characteristic official attitude. Ophthalmic surgeons themselves are the best judges of the time which they have at their disposal, and the ordinary amenities of social life should have suggested that they at least should be consulted and offered the opportunity of giving their assistance when it is proposed to put their recommendations into action.

THE project, which has been in abeyance for some considerable time, for a ship canal across the Scottish isthmus lying between the Firth of Forth and the Firth of Clyde has lately been revived, partly in consequence of the direction of military opinion towards the strategical value of such a waterway in time of war, and partly also on account of the substantial commercial advantages which would accrue generally. A question on the subject was recently put in the House of Commons, and Dr. Addison, in reply, stated that the matter was under the consideration of the Department of Reconstruction in view of the opening afforded for the utilisation of the labour of demobilised men for the execution of the undertaking. We observe, in the issue of *The Engineer* of November 30, an interesting account of the inception and development of the underlying idea, which was promulgated, in the first instance, so far back as the year 1724 by Daniel Defoe. At present there are two schemes which have been elaborated. The first consists in linking up the rivers Forth and Clyde by the most direct route through the Kelvin valley. The second route, avoiding the congested district of the Upper Clyde, lies along the Forth valley, leaving the river channel near Alloa and ultimately reaching Loch Lomond by means of Endrick Water. A short auxiliary connection between Loch Lomond and Loch Long at Arrochar would then complete the passage to the sea. The broad difference between the two routes is that the Loch Lomond route would be at the loch level, while the direct route would be at the level of high water of spring tides. Exigencies of space forbid us to attempt even a summary of the relative advantages and difficulties of the rival schemes, each of which has its convinced supporters.

WE regret to learn that Dr. A. M. W. Downing, formerly superintendent of the "Nautical Almanac," died suddenly on Saturday, December 8, at sixty-seven years of age.

LADY ROBERTS's Field Glass Fund, which has now issued 30,000 instruments to the Army, has no funds beyond the sum necessary for returning the glasses to their owners when this is desired. The main expense is that of repairing the glasses which come back for re-issue. An appeal is made for the sum of 1000*l.* to meet the repairing bills, and the need justifies the request. The address for sending contributions (also any field-glasses and telescopes that can still be spared) is the Manager, Lady Roberts's Field Glass Fund, 64 Victoria Street, S.W.1.

THE Executive Committee of the Automobile Association has decided to offer a prize of 1000*l.* for the best invention which will enable coal-gas to be used with advantage as a propellant of motor-cars and motor-cycles. Communications relating to this subject should be addressed to the Secretary, Automobile Association and Motor Union, Fanum House, Whitcomb Street, W.C.2, and marked "Coal Gas."

IT was announced at the Linnean Society of London on November 29 that a new Linnean Society has been established recently in Sweden as "Svenska Linné-Sällskapet," intended as a means for spreading information about Sweden's greatest naturalist, Carl von Linné (1707–78). The society purposes to do this by publication of works by Linné and his pupils; to throw

new light from modern viewpoints on Linné's personality; to draw up a catalogue of all known memorials; and to found a complete Linnean library. The president is Dr. Tycho Tullberg, a lineal descendant of Linné.

The following are among the lecture arrangements at the Royal Institution before Easter:—Prof. J. A. Fleming, a course of six experimentally illustrated lectures, adapted to a juvenile auditory, on "Our Useful Servants: Magnetism and Electricity"; Prof. W. M. Flinders Petrie, three lectures on Palestine and Mesopotamia—discovery, past, and future; Prof. Arthur Keith, three lectures on the problems of British anthropology; Dr. Leonard Hill, two lectures on (1) the stifling of children's health, (2) the climatic adaptation of black and white men; Sir R. T. Glazebrook, two lectures on the National Physical Laboratory; Sir Napier Shaw, two lectures on illusions of the atmosphere; Prof. W. J. Pope, two lectures on the chemical action of light; M. Paul H. Loyson, two lectures on the ethics of the war; Sir J. J. Thomson, six lectures on problems in atomic structure. The Friday meetings will commence on January 18, when Sir James Dewar will deliver a discourse on studies on liquid films. Succeeding discourses will probably be given by Prof. J. Townsend, Prof. A. S. Eddington, Principal E. H. Griffiths, Prof. A. G. Green, Prof. E. H. Barton, and Sir J. J. Thomson.

In the October issue of the *Agricultural Journal of India* (vol. xii., part iv.), Mr. Wynne Sayer discusses the present position of sugar manufacture and the measures required to place it upon a permanently sound basis. Notwithstanding the present high price of sugar, there is an actual decline in cane cultivation in India, notably in Bengal. Various reasons are propounded for the moribund state of the Indian white sugar industry, such as the predominance of low-grade varieties of cane, the popularity of unrefined sugar or *gur*, minute subdivision of the land, and the competition of crops, such as paddy, jute, and cotton; but it is urged that the greatest difficulties arise from the grossly inefficient manufacturing methods used. Where modern, well-managed factories exist, Indian sugar can be produced at a sufficiently low cost to compete with foreign sugar. Great improvements are also required in the *gur* industry, where inefficient methods commonly reduce the possible output by 35 to 50 per cent. Immediate action is urged with the view of placing both the *gur* and the white sugar industries on a satisfactory basis. The nomination of a strong committee of experts is suggested for the purpose of carrying out a survey of the sugar-producing areas and of considering the extent to which State assistance to the pioneer factories may be needed.

In the September-October number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* Prof. Marcel Brillouin discusses the question of the desirability of establishing in Paris a research and test laboratory for the musical instrument trade. He submits that any experiments carried out by individual firms have a value that is strictly limited to the manufacturers concerned. Further, such researches are not available to the majority. The laboratory which he now proposes should be created, at the common expense of all musical instrument makers, would comprise three sections: (1) Raw materials; (2) instrumental acoustics; and (3) testing and verifying. The laboratory would be staffed by a certain number of physicists qualified by their training to carry out the work satisfactorily. Section (1) would deal with the physical and mechanical properties of every raw material entering into the composition of pianos, and string, wood-wind, and wind instruments; section (2) would deal with researches in sound as applied to instruments, utilising the theories of Helmholtz, Rayleigh, Stokes, Gouy, Hugoniot, and others; while section (3) would consider methods of checking and testing instruments and their parts and implies the close co-operation of manufacturers. Hitherto German manufacturers—especially of pianofortes—have made very extended use of the results of Helmholtz and other authorities on sound, and it is claimed that the suggested new institution would go far, by utilising existing knowledge, to obtain empirical data which, in combination with the artistic (as applied to tone-quality) peculiarities of individual firms, could not fail to improve the quality of musical instruments in general.

The death is announced, in the German Army Geological Service, of Prof. Fritz Daniel Frech, professor of geology and palæontology in the University of Breslau. Born in Berlin on March 17, 1861, Prof. Frech was educated in the University of that city, and graduated as Ph.D. in 1885. His thesis dealt with the coral-fauna of the Upper Devonian rocks of Germany, and he devoted his life to the study of fossil invertebrata, with special reference to their use in stratigraphical geology. For a few years he was engaged on the geological survey of Prussia, and among his early publications was an official memoir on the geology of Nassau (1888). In 1893 he was appointed successor of Prof. Ferdinand von Roemer in the University of Breslau, and he immediately began to direct most of his energies to the great compendium of stratigraphical geology which von Roemer had planned and just begun under the title "Lethæa Geognostica," following a similar work of earlier date by Bronn. Prof. Frech himself wrote the greater part of the section relating to Palæozoic formations and the whole of the volume describing the Trias, besides editing some sections of later parts of the treatise by other authors. So far as completed, this is the most exhaustive and useful work of reference on stratigraphical geology that has hitherto appeared, and is full of interesting generalisations based on broad views and wide experience. A few years ago Prof. Frech planned another important work of reference, a "Fossilium Catalogus," intended to comprise a systematic list of all known fossils, critically compiled with full quotations of literature by a series of specialists. He himself contributed the section on Devonian Ammonoidea and edited a few other sections, but, as publication did not begin until 1913, little progress has naturally been made. In 1913 Prof. Frech also succeeded Prof. Ernst Koken as one of the editors of the *Neues Jahrbuch für Mineralogie*. His energy was equalled by his ability, and geological science is distinctly the poorer by his loss.

The contrast between Oriental and Western thought is well illustrated by a curious list, published in *The New East* (vol. i., No. 5), entitled "190 Things Japanese do differently." In Japan a man is free, woman carries the burdens; in the West "man acts as the packhorse for his lady." Japanese wear the thimble between the first and second joints of the middle finger of the right hand, Europeans on the tip of the middle finger; a Japanese tacks the kimono after, the European before, stitching. The Japanese mother-in-law is a terror to the bride; in Europe she is the husband's bugbear. The Japanese blow their noses with both hands; Europeans usually with one. The Japanese carpenter pulls at his saw; the European carpenter uses his triceps muscle rather than his biceps. Japanese take off their shoes, Europeans their headgear, on entering a house. Japanese say "four

or three " where Westerns say "three or four"; and so on. If these facts were rearranged so as to exhibit the physical as well as the moral differences between Japan and Europe, the result might be some scientific importance.

In a lecture delivered at the Calcutta Museum, reported in the *Pioneer Mail* of September 1, Mr. Percy Brown discussed Indian artistic metal work. The most valuable specimens were executed in the medieval period of Indian history—that is, from the eighth to the eighteenth centuries A.D. Mr. Brown directed special attention to the copper colossus of Buddha found at Sultanganj, in the Bhagalpur district, Bihar. This figure is practically unique and almost unknown. It has been traced with some difficulty to a provincial museum in England. This statue of Buddha stands alone, as several centuries separate it from the other statues of the northern school, which are of the Vishnuvite Hindu type, and belong to the eleventh century A.D. Another admirable piece of work is a little shrine discovered at Dacca, and now in the Indian Museum. It is only 9 in. in height, but for richness of design and finish of workmanship it is the best specimen of this school. It represents Vishnu with the goddesses Sarasvati and Lakshmi, and his symbols, the wheel, mace, conch, and lotus. The figures of the goddesses with their graceful attitudes form an admirable foil to the dignified conventional image of the god.

The new part of the Proceedings of the Prehistoric Society of East Anglia (vol. ii., part iii.) contains the usual profusion of beautiful drawings of flint implements and several noteworthy papers. Grime's Graves again receive much attention, and there is still a tendency to regard them as Palæolithic, but Mr. W. G. Clarke admits "that there is nothing in the knowledge available which actually precludes a Neolithic date for the Graves, and that there is a considerable amount of data concerning fauna and implements which supports that view." Mr. Henry Bury describes some interesting flat-faced palæoliths from Farnham, and discusses their possible relationship to the rostro-carinate implements of earlier date without any conclusive result. Mr. R. H. Chandler and Mr. J. Reid Moir contribute observations on the flaking of flints, and the latter author proposes that "flaking diagrams" of flint implements should be prepared to facilitate comparisons. Mr. R. A. Smith touches geological problems in his elaborate paper on plateau deposits and implements, showing the frequent difficulty of distinguishing between deposits formed by existing rivers and those due to an earlier distinct system of drainage. For students of man in the Stone age the number is indeed full of interest from all points of view.

The present condition of the Quichuas of southern Bolivia is briefly, but ably, summarised by Mr. L. E. Miller in the *American Museum Journal* for October. These people represent a part of the wreckage of the ancient Incan Empire left by the Spanish invaders. Of the physical characters of this tribe nothing, unfortunately, is said, but to the ethnologist this account will be most welcome. In the upper reaches of the Pilcomayo the Quichuas are still to be found in almost their primitive simplicity, both in the matter of customs and of dress. In the latter particular, indeed, they seem to have changed but little since the days of Atahualpa. No jewelry or ornaments of any kind seem to be worn, save huge, spoon-shaped pins of copper, used by the women to fasten their shawls. The llama, once their chief source of food and clothing, is now being replaced by sheep and goats. But the llama is still used as a beast of burden, and blankets of superb quality are still made of its wool. Unfortunately, the yoke of the Spaniard still presses heavily on these wretched people, and the author gives instances of the treatment they have to bear with what equanimity they may, for no redress is theirs.

The directors of the Wistar Institute, Philadelphia, have initiated a bibliographic service which will prove to be a great saving in time and trouble to all biologists. At the present time the leading biological journals of the United States—the *Journal of Morphology, Journal of Comparative Neurology, American Journal of Anatomy, Anatomical Record,* and *Journal of Experimental Zoology*—are managed and issued by the Wistar Institute. For the sum of three dollars per annum the directors of that institute undertake to supply index-cards, which, when filed, will serve as a subject index and an author index to all publications appearing in their journals. An outstanding feature of the scheme is the abstract of each paper, which is printed on the back of the author index-card.

The first number of the new *Journal of Urology* (Baltimore, Ind., U.S.A.; London: Cambridge University Press) has reached us. Its object is the publication of original papers on the physiology, pathology, and surgery of the urinary tract. It is published in the United States of America under the editorship of Dr. Hugh Hampton Young. The contents of the number before us are of a high order of excellence, and include such topics as the surgery of the ureters, the cultivation of tumours *in vitro,* the physiology of the ureter and vas deferens, the effect of the intravenous injection of various substances on the composition of the blood and urine, and on nitrogen metabolism. There can be no question as to its usefulness to those engaged in the special branch of medical practice with which it is concerned; but, at the same time, some doubt may arise as to the wisdom of the publication of papers on more general questions, such as nitrogen metabolism, presumbly because certain products of this chemical activity are excreted in the urine. It would seem that such questions as these belong more appropriately to the less special journals. A useful addition to the *Journal of Urology* would be a section devoted to the giving of the titles, and perhaps abstracts, of papers which bear on the special province of that journal, although they appear in other periodicals. There must be many such papers. The new journal is of attractive appearance and well illustrated.

The *Comptes-rendus des travaux du Laboratoire de Carlsberg* (1917, vol. ii., part 6) contains an important article by Prof. A. Klocker on the preservation of fermentation organisms in nutrient media. Hansen's conclusion that a 10 per cent. solution of cane-sugar forms an excellent medium is confirmed, but beer wort is also very good. The Pasteur flask is undoubtedly the best form of vessel for prolonged preservation. The present observations were made, during a period of more than thirty years, on 820 cultures of yeasts and moulds. These included Saccharomycetes, Schizosaccharomycetes, Torulæ, Mycoderma, Endomyces, Monilia, Chalara, Oidium, and Mucor. For the most part the nutrient medium employed was a 10 per cent. solution of cane-sugar, in which 461 cultures were grown, but 290 cultures were made on beer wort and sixty-nine on other media. Of the 461 cultures on cane-sugar solution (231 of these being Saccharomyces) 403 survived, whilst 58 perished. In the case of the 290 cultures grown on beer wort (190 Saccharomyces) 268 survived and 22 perished. Thus it must be concluded that fermentation organisms can be kept alive for upwards of thirty years. The exceptions to this

rule are:—(1) The asporogenic varieties of Saccharomyces; (2) *Saccharomycodes Ludwigii*; (3) Schizosaccharomyces; and (4) *Aspergillus glaucus*. Of the first only 44 per cent. survived on cane-sugar and 21 per cent. on beer wort, of the second only one in nine survived on cane-sugar for more than 7·5 years, but all five cultures on beer wort survived for twenty-five years. Only two out of five cultures of Schizosaccharomyces on cane-sugar survived, but ten out of eleven of those on beer wort were living. Of six cultures of *A. glaucus* only one survived, and two of the remaining five perished in less than two years.

THE first annual report of the Zoological Survey of India, a new and promising transformation of the Indian Museum Cinderella, contains a great deal of interesting information. New ground was broken in the Shan States, where the director of the survey, Dr. Annandale, personally superintended a survey of Lake Inlé. The basin of this lake is stated to have been formed by solution, in limestone rock, and to be filling up with silt and aquatic vegetation; the water is shallow and of extraordinary limpidity; floating islands are a notable feature; fishes of many new species were discovered, for three of which new generic definitions are necessary, among them a minute eel so peculiar as to require seclusion in a new family; the molluscs are scarcely less remarkable, and among them occurred a group of pond-snails interesting not only for the bizarre shape and bright colour of their shells, but also because an almost complete series of forms transitional between them and nearly normal forms was found in other parts of the lake, in other neighbouring waters, and fossil in the surrounding country. Mr. Kemp, superintendent in the survey, investigated the Mutlah channel of the Gangetic delta; this is a deep and permanent channel, and its waters, which are never very salt, are heavily charged with silt; a remarkable feature of its fauna is said to be the extraordinary resemblance of some of its fishes and crustacea to deep-sea forms, in colouring, in gelatinous translucency, and in filamentous feeler-like appendages. Dr. Chaudhuri, an assistant-superintendent in the Survey, paid a visit to certain large tanks in Seringapatam, where a century ago Buchanan-Hamilton obtained several species of fishes that have never since been brought to light; Dr. Chaudhuri was successful in rediscovering some of them. A feature of the report, as an official departmental publication, are the excellent illustrations.

MR. A. M. HERON (Mem. Geol. Surv. India, vol. xlv., part i., 1917, price 4s.) describes the results of a re-survey of north-eastern Rajputana, where the Archæan Alwar quartzites run south from Delhi and form hills with remarkably level crests. Some revision of the stratigraphical sequence is proposed; an "arkose" series is shown to be in reality a granite intrusive in the Delhi system; and the planing of the Alwar crests is interestingly ascribed to subaerial action going back to the Jurassic period. The deepening of stream-beds among dissected sandhills seems to point to a diminution of aridity in Rajputana.

AN elaborate memoir on "The Origin of Dolomite," by Francis M. van Tuyl, appears in the annual report of the Iowa Geological Survey for 1914 (1916), and would be important merely on account of its references to previous work. The author concludes that "the great majority of the stratified dolomites have had their inception in the alteration of limestones." He is unable to accept Klement's work at high temperatures, or Pfaff's at high pressures, as bearing on the natural problem, but agrees with Steidtmann and Wallace (see NATURE, vol. xciv., p. 459) that greater concentration of salts in the sea-water has much to do with dolomitisation of limestone already laid down. Illustrations are given from North American geology.

THE depredations of the boll weevil on the American cotton crop in recent years have led to the replacement of cotton-growing in large areas by the cultivation of groundnuts (*Arachis hypogaea*). According to *Agriculture* of March last, the value of the groundnut crop in the United States has increased in the eight years from 1908 to 1916 from twelve million to fifty-six million dollars. It has been found that by slight adjustments of machinery cotton-seed mills can be used for crushing groundnuts. An increasing proportion of the crop, however, is being utilised for food purposes in the uncrushed state. Efforts are being made by the Government to discover the best use for the groundnut and to popularise it with American kitchens, and experiments in progress under the auspices of the Chemistry Bureau of the Department of Agriculture are said to promise the production from groundnut meal of a bread equal in nutritive value and palatability to wheaten bread.

SCIENTIFIC PAPER 301 of the Bureau of Standards describes a calorimeter devised by Mr. N. S. Osborne, of the Bureau, for the determination of the specific heats and latent heats of evaporation of materials used in refrigerating machines, *e.g.* ammonia, carbon dioxide, sulphur dioxide, methyl and ethyl chlorides. Ammonia has already been investigated over the temperature range $-40°$ C. to $40°$ C.; the other substances are to be dealt with and the results published later. The calorimeter is of thin steel, about 4 cm. in diameter and 10 cm. long, with a central electric-heating coil. It is enclosed in a steel jacket capable of withstanding a considerable pressure. The temperature of the calorimeter is measured by means of a platinum thermometer, and the jacket is maintained at the same temperature as the calorimeter to diminish heat losses. The measurements already made show that an accuracy of one part in a thousand can be secured.

THE difficulty of getting coloured lines in exact juxtaposition and of sufficient fineness for the purposes of colour photography has, according to *La Nature* for November 10, been completely overcome by M. Louis Dufay, who is associated with the brothers Lumière. The method is to pass a thin celluloid film between two rollers warmed sufficiently to render the celluloid plastic. One of the rollers has very fine circumferential parallel grooves of square section cut upon its surface, and thus the celluloid has similar grooves formed upon it. The film is then coated with a coloured transparent fatty mixture and wiped off after the manner of wiping an etched plate after inking and before taking an impression from it. The film is next treated with an alcoholic solution of another colour, and this penetrates the exposed surface of the celluloid. Thus there are formed alternating coloured lines in perfect juxtaposition, which may be of a fineness as great as thirty lines to the millimetre. If the film is thin enough to permit it without introducing the possibility of parallax, the other side of it may be similarly treated, either simultaneously or afterwards, so that two other colours may be introduced, or these may be added in the form of any microscopic figures that may be preferred. Three double pairs of colours are given: (1) yellow and blue, red and green; (2) yellow and red, blue and orange; (3) red and blue, yellow and violet.

ATTENTION may be directed to a useful collection of data respecting the absorption of atmospheric gases by water, given in a paper contributed by Mr. J. H. Coste to the Journal of the Society of Chemical Industry for August 15. As regards the significance of

the gases dissolved in natural waters, the conclusion is that water freely exposed to the air should, and does, contain the proportion of gases of the air corresponding with the temperature and saline content of the water, provided these have not been recently changed. In respect of oxygen, all the ascertained facts show that if water is found to contain very much less of this gas than the saturation-value for the particular temperature in question, a strong presumption is raised that the water contains matter undergoing oxidation. Since, however, the water may have recently fallen in temperature, the deficiency of oxygen may be only an apparent one, due to the fact that equilibrium between the atmospheric gases and the dissolved gases has not yet been established under the new conditions. In such cases, therefore, the point can only be settled definitely by determining the nitrogen—the constituent which, so far as is known, is not taken up chemically by anything in the water. It appears that slow non-tidal streams will give unpleasant signs of the presence of decaying matter at much higher degrees of aeration than deep streams with strong tidal currents. This is probably due to a variety of causes, such as slowness of downward diffusion in the less rapid streams, and the accumulation of undisturbed mud which, in fermenting, gives off gases that have but little opportunity of being absorbed in their passage upward through the layer of relatively still and shallow water of the slow non-tidal streams. No fewer than seventy-six references are included in the bibliography of the subject given by the author.

THE Engineering Experiment Station of the University of Illinois has published a brief report upon experiments on the utilisation of pyrites occurring in Illinois bituminous coal, drawn up by Mr. E. A. Holbrook. It appears that some of the Illinois coal seams contain bands, nodules, or lenses of pyrites in considerable quantity; these are for the most part thrown out in the course of getting the coal, and thrown back into the goaf, whilst others are picked out at the surface. The proportion of pyrites in the coal refuse varies from 7½ to more than 40 per cent., and whilst it carries too much carbonaceous matter and too little sulphur to be available for sulphuric acid manufacture without treatment, it is shown by these experiments that by simple crushing, screening, and dressing by means of jigs and tables, it is easy to get a product with 40 to 45 per cent. of sulphur, with a recovery of 80 per cent. of the pyrites present. Details are given of the plant proposed for this purpose and of its first cost, whilst an estimate of the cost of operating a plant capable of treating 50 tons of crude pyrites in eight hours shows a very reasonable working profit. It is interesting to find that the possibility of recovering and utilising this hitherto waste material is attracting attention.

THE latest catalogue of Mr. F. Edwards, 83 High Street, Marylebone, W.1 (No. 379, "Drama and Dramatic Art"), is not of very especial interest to readers of NATURE, but attention may be directed to the following volumes on North American Indian tribal customs:—"The 'Hako,' a Pawnee Ceremony," A. C. Fletcher; "The Mountain Chant, a Navajo Ceremony," Matthews; "The Sioux Outbreak of 1890 and Ghost Dance Religion," Mooney; "Ceremonial of Haszelti Dailjis and Mythical Sand Painting of the Navajo Indians," Stevenson; "Tusayan Flute and Snake Ceremonies" and "Tusayan Snake Ceremonies," Fewkes; "The Zuni Indians; their Mythology, Esoteric Societies, and Ceremonies," M. C. Stevenson.

SIR WILLIAM TILDEN has just completed his life of the late Sir William Ramsay, and placed it in the hands of Messrs. Macmillan and Co. for publication.

OUR ASTRONOMICAL COLUMN.

FALL OF A METEORITE IN PERTHSHIRE.—On December 3, at 1.15, what is stated to be a meteorite struck the lodge at Keithick House, Coupar Angus, which is about twelve miles N.E. from Perth. In the Blairgowrie, Coupar Angus, and Strathmore districts a noise was heard resembling a peal of thunder, and at places more remote sounds as of a distant explosion were audible. The meteorite has been taken to Perth for proper examination and analysis. It appears to have been well seen by an observer at Edinburgh during its flight. The time was 1.10 p.m., and the object descended at an inclination of about 12° from the vertical to the left, and disappeared in about azimuth 4° W. of N., at an estimated altitude of 30°. This agrees very nearly with the required direction of a body falling at Coupar Angus, which is in slightly W. azimuth from Edinburgh.

Further information shows that three fragments of the meteorite have been found, weighing 22½ lb. (which penetrated the ground to a depth of 20 in.), 2½ lb. (which entered the roof at Keithick Lodge, Coupar Angus), and 2¼ lb. (found in a field at Carse Farm, near Blairgowrie, 6 in. below the surface). These pieces were distributed over a distance of six miles in a S.E. to N.W. direction, and sufficiently prove the direction of the meteor's motion.

From the various observations, now about twelve in number, of the luminous flight of the meteorite, it appears probable that its radiant point was in about 302°+24°. This position would correspond in direction with the line of the fallen fragments from Keithick to Essendy. The meteor seems to have passed over the Firth of Tay, about four miles S.W. of Dundee, and at a height of twenty-five miles, and to have entered over the Scotch coast from the North Sea near Fife Ness, but it is hoped that further observations will enable more certain and exact conclusions to be obtained.

A large number of persons witnessed the luminous flight of the object, and are sending to Mr. W. F. Denning observations from which it is hoped to compute the real path. The meteor was strikingly brilliant, though the sun shone at the time.

OBSERVATIONS OF LONG-PERIOD VARIABLES.—A valuable series of recent observations of twelve long-period variable stars is recorded by M. Luizet, of the Lyons Observatory, in the *Journal des Observateurs*, vol. ii., No. 2. Some of the results are collected in the following table:—

Star	No. of maxima observed	No. of minima observed	Mags. at maxima	Mags. at minima	Period in days
SS Draconis	9	10	8·6–9·1	9·3–9·5	48·2
V Urs. Min.	14	11	7·8–8·2	8·3–9·1	72·1
RR Boötis	6	1	8·2–9·5	12·6–12·8	194·0
AF Cygni	6	2	6·8	8·0	96·8
UU Draconis	9	8	8·8	10·1	Irregular
SV Cassiopeiæ	1	1	7·3–8·4	9·1–10·1	279·4

The other stars observed were UV Draconis, V Aquilæ, SS Cygni, X Herculis, TZ Cassiopeiæ, and V Cephei.

MESSIER'S CATALOGUE OF CLUSTERS AND NEBULÆ.—In *L'Astronomie* for November, M. Camille Flammarion gives the first instalment of a systematic review of the 103 clusters and nebulæ which were included by Messier in the earliest catalogue of such objects which was compiled. M. Flammarion relates how he came into possession of Messier's manuscript, containing detailed remarks on each observation, through good fortune at a second-hand bookstall, and he is thereby enabled to give the original account of each object. Observations commenced by M. Flammarion forty years ago, and afterwards continued with the collaboration of M.

Trouvelot and others, are to be utilised for a descriptive account of the Messier objects in the proposed series of articles. Following an interesting biography of Messier, a useful list of the objects is given, with the original positions and numbers, and positions for 1900, together with the N.G.C. designations. M1 and M2 are described in detail in the first article, and each is illustrated by a photograph, and by a drawing showing the appearance in a telescope of 0·24 m. aperture. It is interesting to note that the present publication coincides with the centenary of the death of Messier, who died at Paris in 1817, at the age of eighty-seven.

SCIENCE IN INDIA.[1]

THE report of the Indian Association for the Cultivation of Science for the year 1915 contains, as well as the usual presidential addresses, a miscellany of scientific papers, ranging from ancient Hindu astronomy and the metallurgy of the Rig Veda to modern anthropological methods and problems of isomerism. Physics and chemistry come in for more attention than the biological sciences; in the former category the more important contributions are those of C. V. Raman and Ashutosh Dey on discontinuous wave motion, of S. Banerji on experiments with the ballistic phonometer, and of J. C. Ghosh on a new method of preparing colloids; in the latter a careful and intelligent analysis of the vegetation of the mouth of the Hugli by N. B. Dutt must be mentioned.

The address of the president, Raja Peary Mohun Mukherjee, is a reminder that the association, although it has always held the advancement of science by research and experiment to be its final purpose, started in life with a mission, which it still upholds, for imparting instruction in the general principles of science; though brief, the address abounds in wise reflections and sage advice adjusted particularly to the educated youth of Bengal.

Some of the special addresses allude to the recent establishment of a University College of Science in Calcutta, and to the opinions expressed in some quarters that thereby the association, on its educational and investigative side, may now be considered superfluous. It is to be hoped that such short-sighted views may not meet with any encouragement; for of all the misconceptions that have attended science since it was taken in hand by bland official personages that about "overlapping" makes the most unfortunate departure from inceptive truth. So far from being a stumbling-block, overlapping in the domain of science brings manifold strength and quintessential purification, for the more widely a scientific theory is tested and criticised the less likely is it to be a source of illusion.

ALKALI SOILS AND SOIL SOLUTIONS.

IN any attempt at agriculture in arid or semi-arid regions, considerable trouble is likely to arise from accumulations of soluble salts at the surface of the soil. The trouble is often intensified by irrigation, and it may become so serious as to counteract the advantages of a reclamation scheme that may be satisfactory in other respects. In a recent issue of the *Journal of Agricultural Research*, Dr. Breazeale estimates that the losses from this cause have already amounted to one hundred million dollars in the United States alone, and the evil is by no means checked. The soluble salts arise from two causes. Some come direct from the weathering of soda feldspars, diorite, etc.; much, however, arises from the circumstance that the area was once largely covered by marine lagoons or landlocked seas, the water of which evaporated, leaving the salts behind. When the soils are first brought under irrigation, the water applied to the higher levels is usually excessive in amount, and drains through the lower ground, carrying with it in solution considerable amounts of the chloride, sulphate, carbonate, and bicarbonate of sodium. Calcium carbonate is almost invariably present in the soil, and both sodium chloride and sodium sulphate react with this to produce sodium carbonate, which is much more harmful to vegetation than the other salts. The action is, however, reversible, and the addition of calcium sulphate to the soil has long been a recognised method of reducing the amount of sodium carbonate. The method, however, has not always succeeded, and Dr. Breazeale is able to furnish an explanation from his curves showing the amount of carbonate formed from the various sodium salts. If the carbonate is arising from the interaction of sodium chloride or sodium nitrate with calcium carbonate, then calcium sulphate is effective in bringing about the reversal; if it arises from sodium sulphate, then calcium sulphate is without effect.

The study of the soil solution is of great importance, both in relation to soil formation and because it is the medium for plant growth and the substratum for microbial life. The difficulty is to obtain sufficiently large amounts of the true soil solution. The drainage water does not faithfully represent the soil solution, soil extracts (using water as a solvent) only yield dilute washings of the soils which cannot be concentrated to reproduce the original solution, and the centrifuge only separates moisture from a soil which contains more than the optimum amount. A paraffin-oil displacement method under pressure has been devised by van Suchtelen and Itano, which has been used by Mr. J. F. Morgan. Some of the results obtained are described in the June number of *Soil Science*. The method consists of forcing paraffin oil, by means of a high-pressure pump, through the soil tightly packed in a cylindrical vessel, the pressure being raised so long as moisture is expelled, until it reaches 500 lb. per square inch. In the case of most soils ample solution for the necessary analytical work is obtained—from sandy soils as much as 74 per cent. of the moisture present—and a large amount of solution is yielded without its coming in contact with the oil. From the results of his experiments the author concludes that the method furnishes a fair representative of the solution as it exists in the soil. Successive portions of the same extraction vary only slightly in physical properties, but to a considerable extent in the various forms of nitrogen (ammonia, nitrite, and nitrate). In the different soil solutions phosphoric acid is fairly constant, but calcium, magnesium, and potassium vary, as do the forms of nitrogen. The obtaining of a soil solution by the method is limited to the moisture content of the soil, and depends upon the type of the latter, since all soils are not entirely penetrated by the oil. Work Mr. Morgan has in progress indicates that the method furnishes a valuable index of the microbial changes in the soil.

LOCAL NATURAL HISTORY SOCIETIES.

THE report of the Winchester College Natural History Society for 1915–17, edited by its president, the Rev. S. A. McDowall, shows that a considerable amount of active work is being done by the members. Mr. McDowall himself is interested in natural orchid-hybrids, and he has succeeded in infecting the older members of the society year by year with his enthusiasm; the present report contains valuable notes by H. McKechnie and D. G. Lowndes, with five good half-tone plates. The former also has an interesting

[1] Report of the Indian Association for the Cultivation of Science for the Year 1915. Pp. iii+150. (Calcutta: Anglo-Sanskrit Press, 1917.)

account of plants introduced from camp fodder. There are lists of additional plants, of Lepidoptera, and of nesting birds, with locality and date of each observation. A golden oriole and a waxwing are among the birds observed. Among papers read at the meetings (which, by the way, are held on Sundays), those by R. F. Lowndes on trout and by J. Comber on ditch plants bear witness to much first-hand knowledge, and are rightly printed at greater length than the others. Although the war has introduced many competing claims on the energy of the school, the membership of this society has not diminished, and all, from its president down to the smallest junior, are to be congratulated on the excellent report that their united efforts have produced. We hope that in this time of stress other schools will do as well in natural history as does this home of the ancient learning.

The Transactions of the Hertfordshire Natural History Society for 1917 contain much interesting matter. Dr. A. H. Foster, a very sound ornithologist, contributes a list of the birds of North Herts; he gives records of 200 species, and, though stray wanderers are included, the list is a remarkable one. Though the county is becoming dotted with small towns and large villages, the birds, being very conservative, still keep to their old haunts and their old lines of migration. Besides this there are a fair number of good observers, so that few rarities pass unnoticed. Among nesting species may be noted especially the grasshopper warbler (scarce and local), the stone curlew, the woodcock, and the quail. Among occasional birds of passage is the common tern. A regular winter visitor is the golden plover; in the south of the county these birds frequently don the black breast before starting for the north. Surely, then, Dr. Foster must be wrong when he says they never do so in the district of which he writes. He has as yet no record of the breeding of the redshank, which nests regularly in Essex, and shows signs of extending its range over the border into Herts. For the common snipe the record is "a few nesting pairs in summer and many individuals in winter." Do these winter and summer birds belong to different sets which keep apart? A paper on "The Response of Plants to Selective Screening," by Col. Rawson, records some valuable experiments that show that variations may be induced in some plants by screening them from the sun when it is at certain altitudes. There is also an interesting paper on Rotifers by T. E. Lones, and a list of the Macro-Lepidoptera of North Herts by Dr. Foster.

The *Vasculum* is an illustrated quarterly magazine devoted to the natural history of Northumberland and Durham, and from the three parts of the current third volume before us it may be seen that it is fulfilling a useful function. The general editor is the Rev. J. E. Hull, whose speciality is the Arachnida, but who also contributes chatty papers on place-names. The other editors are Mr. George Bolam, the author of "Birds of Northumberland and the Eastern Borders," who writes on the coming and going of the birds of the Upper Tyne Valley; Mr. R. S. Bagnall, who records discoveries of spring-tails and their allies new to science and new to the district; and Dr. J. W. H. Harrison, whose recent work in hybridisation has brought him into prominence, who displays in the magazine a wide knowledge of animals and plants and their associations. Other field naturalists of the counties concerned contribute articles, and we note that they represent the other natural history activities of the district—the Natural History Society of Newcastle and Armstrong College. The magazine brings scattered workers in country districts into intimate association, new discoveries are made known, the older workers are stimulated to fresh endeavours, and those who have received the call of natural history are encouraged and guided as to literature and methods. The work of the Northumberland and Durham naturalists is providing material for the presentation of the district from an ecological point of view, and the gathering of the material is fostered by the *Vasculum*.

The Proceedings and Transactions of the Croydon Natural History and Scientific Society for 1916 contain a good deal of detailed information in regard to the intermittent bournes of the district. The late Mr. Baldwin Latham showed that the Croydon Bourne flowed early in 1916, for the fifth year in succession, with a maximum flow of 13,345,920 gallons per day, thus equalling the great flow of 1904. Bournes also flowed at Carshalton, Cheam, Nonsuch Park, Smitham Bottom, and Wickham. With regard to the last-mentioned, Mr. W. Whitaker contributes a paper showing that the Wickham Bourne had not flowed since 1883. On May 28, 1916, it was yielding 1,628,550 gallons per day, at a point where it flowed into and filled up a gravel-pit by the side of the railway near Hayes Station. In Mr. N. F. Robarts's presidential address reference is made to a valuable find of bronze implements made in 1914 in Addington Park, when the golf links were laid out and an enormous destruction of woodland took place. So large was the find that the man who took them away staggered under the weight. Apparently he disappeared, but it was found afterwards that a man had called at the British Museum in the same year and had sold about thirty implements and fragments of bronze from Addington. The find contained six socketed celts, and is thought to be of late Bronze age. The Proceedings contain the usual rainfall returns from more than a hundred stations, compiled monthly by Mr. F. Campbell-Bayard, and these are of great value to water engineers and others. The society may be congratulated on the energy displayed in spite of pressing war vocation.

The 1917 issue of the *South-Eastern Naturalist* constitutes the twenty-second volume of Transactions of the South-Eastern Union of Scientific Societies, and includes the proceedings at the annual congress held in London last June. This meeting was reported in our issue for June 28 (vol. xcix., p. 354), when summaries were given of Dr. W. Martin's presidential address and the more important papers read at the meeting. Among the contributions to which limitations of space made any detailed reference impossible on that occasion may be mentioned Dr. B. Daydon Jackson's well-informed directory to the notable trees and old gardens of London, with its references to the gardens of Gray's Inn, planted by Sir Francis Bacon; and those of Syon House, at one time under the superintendence of Dr. W. Turner, physician to the first Duke of Somerset, Lord Protector. Dr. Turner, the "Father of English Botany," published "The Names of Herbes" in 1548, and dedicated it to the Protector. Prof. MacBride's address on "Are Acquired Characters Inherited?"; Dr. J. S. Haldane's on "Abnormal Atmospheres and the Means of Defence against Them"; and Prof. Boulger's on "The Association of the Chelsea Physic Garden with the History of Botany," are all printed *in extenso*.

PARASITIC BIRDS.

THOUGH the singular habits of the parasitic cow-birds (*Molobrus bonariensis* and *M. badius*) are well known to ornithologists, Mr. L. E. Miller has been able to add still further to the records of their eccentricities in a valuable paper published in the Bulletin of the American Museum of Natural History, vol. xxxvii. His observations were made during a recent expedition to Bolivia and north-western Argen-

tina, where he found these birds in considerable numbers foisting their eggs upon numerous species of small birds, especially finches. But for choice they seem always to prefer the mud nests of the oven-bird (Furnarius). These seem to have an irresistible and fatal attraction for cow-birds, since all the eggs deposited therein appear invariably to be destroyed by the desertion of the intended dupes, which, whenever they discover the trick that has been played upon them, cover up the eggs with a layer of nesting material, refusing to incubate. In some nests layer after layer of eggs were thus found, but no young were ever met with. The numbers of eggs found in such nests ranged from six to as many as thirty-seven! While this stupidity reduces the numbers of the parasites, it at the same time reduces the number of oven-birds, which, in the areas explored by Mr. Miller, failed to produce offspring. Judging from the coloration of the eggs, Mr. Miller estimated that in some cases as many as thirteen birds may use the same nest. The eggs of a third species (*M. rufoaxillaris*) were also occasionally found in these nests.

That the pin-tailed widow-bird has developed the parasitic habits of the cuckoo seems to be established, judging from the evidence of Mr. Austin Roberts in the Annals of the Transvaal Museum, vol. v., part 4. Mr. Roberts tells us that he has known this bird to deposit its eggs in the nests of no fewer than four different species of waxbill, as well as in those of its relative, the red-collared widow-bird. It frequently deposits more than one egg in the nest of its host, and sometimes it replaces the whole clutch. But in no case does the foundling appear to dislodge the rightful occupants of the nest, which is the invariable custom of the cuckoo. Mr. Roberts believes that two other finches are similarly parasitic. These are Rendall's seed-eater (*Anomalospiza imberbis*) and the red-billed weaver (*Quelea sanguinirostris*). But we venture to think that a mistake has been made, at least in the case of the last-named species, which even in capitivity shows no degeneration in the matter of its parental instincts.

SCIENCE AND ITS FUNCTIONS.[1]

SINCE the earliest times, man, like his poor relation the monkey, has always been of a curious disposition, and has wanted to know the why and wherefore, as well as the mechanism, of all the phenomena that he sees about him. No doubt much early science, especially in the fields of astronomy and alchemy, was practised as a cult, with the view of impressing and mystifying the common people, but at the back of it all there can be little question that the great force that impelled inquiry into Nature, both in ancient times and in the modern world, was curiosity, which in itself is probably of all human emotions the one that has been most conducive both to intellectual and to material progress.

With the appearance in history of that wonderful people the Greeks, we come for the first time in personal contact with the scientific thoughts and the scientific theories of individual philosophers. Prior to that period there must have been scientific thinkers, but we have no distinct record of what their scientific ideas were. All that remains are portions of some of their material constructions, and some accounts of others that time and decay have destroyed. Thales of Miletus, one of the seven wise men of the Grecian golden age, though he lived some 600 years before our area, is no mere name. He was the founder of the physical school of Greek philosophy, who first began to consider the nature of things, and was the first to observe electrical action. To Democritus, a Greek of the fourth century B.C., we owe the earliest ideas about matter, while to Hippocrates, another early Greek, are due the beginnings of medicine and biology. To him is ascribed the immortal and pregnant phrase that while "Life is short, Art is long, Opportunity fleeting, Experiment uncertain, Judgment difficult"—an aphorism in which is summed up for all time the difficulties with which the scientific investigator has to contend. And so we pass on to that most famous of classical philosophers, Aristotle, whose writings have done more than those of any other man to influence the progress of science, and whose authority was so great that it bound the scientific world in iron fetters for centuries. In the great library and museum which was founded in the third century B.C. by Ptolemy at Alexandria, then the intellectual and commercial capital of the Grecian world, we find the apotheosis of Greek scientific activity. Here were preserved all the scientific writings and records that a world-wide search had enabled the founder to collect. Here were taught the philosophy of Aristotle and the geometry of Euclid. Here Claudius Ptolemy experimented in optics, and wrote his great work on the construction of the heavens. Here Eratosthenes measured the earth. Here Ctesibius invented the fire-engine, and Hero the first steam-engine, which, it is interesting to note, was a simple form of steam turbine. Here worked Archimedes, the most famous mathematician and physicist of the ancient world, who laid the foundation of hydrostatics, elucidated the theory of the lever, and invented the burning-glass and the screw-pump which still bears his name. As a man of science the world produced no equal to him for nearly two thousand years. But the days of the great library were numbered, and within those marble halls the drip of the water-clocks of Apollonius were counting drop by drop, and second by second, the approach of the catastrophe. During the siege of Alexandria by Julius Cæsar the library and all its contents were burnt—a fitting funeral pyre to the glory that was Greece.

The Romans made no contributions to pure science at all to be compared with those of the Greeks. They were a practical rather than a speculative people, and were great builders, engineers, and road-makers. Size, solidity, and quantity rather than novelty were the outstanding features of their scientific work. They were not like the Greeks, ever seeking after some new thing.

When Rome fell into decay, and the gloom of the Dark Ages settled down upon Europe, there was for a time an almost complete halt in the progress of science. True, some vestige of learning still struggled to maintain itself in what was left of the Alexandrian library, but this was finally extinguished by the latter's second destruction by order of the Arabian Khalif, Omar. After this it is somewhat surprising that the next revival in scientific investigation took place amongst the Arabians themselves, now become a highly cultured people. To this revival we owe the invention of algebra, the beginning of systematic chemistry, and much new work in astronomy, medicine, mechanics, and metallurgy. One of the most famous of the Arabian experimental philosophers was Alhazan, who lived shortly before the Norman Conquest of England.

When there began in Europe that great revival of learning known as the Renaissance, it was the printing press that became its principal coadjutor, and caused things to move at a rate much faster and on a scale much larger than ever before. It was with fundamental concepts that the new learning had first of all to contend, particularly with the geocentric theory of the universe, which gave to the earth and

[1] From an address delivered before the Royal Society of Arts on November 21 by A. A. Campbell Swinton, F.R.S., Chairman of the Council.

to human affairs quite an undue importance, and also with the authority of Aristotle, which had become an article of faith and defied all new ideas. By the end of the sixteenth century experimental science, as opposed to the barren speculations of the schoolmen, was again being practised in Europe with noteworthy results, while, a little later, Francis Bacon published his famous "Novum Organon," and thus became the apostle of the revival of this experimental method of attacking scientific problems. On this method, which had been practically abandoned for some hundreds of years, all modern science is based, and as soon as its practice recommenced results of the highest importance began rapidly to accumulate. How a dread of the tentacles of "authority" still lingered in scientific circles is, however, to be seen in the fact that when the Royal Society was founded in 1662 the fellows took for their motto the words, "Nullius in Verba," an [illegible] from a line in Horace which reads, "Not pledged to swear by the words of any master." To-day it is difficult to realise what a hold authority had come to have on even scientific ideas, and how, even as late as the seventeenth century, antiquated and frequently unsound scientific principles, as enunciated in the writings of Aristotle, were still regarded as something that had to be faced when dealing with new problems.

And now we have arrived at a period when there commenced those organised efforts in scientific investigation, and those widespread and continuous endeavours to apply the results thus obtained to practical ends, that have produced during the last two centuries such marked effects on civilisation. We have now, in fact, a better opportunity than ever before of seeing what are the functions of science.

To arrive at some measure of the vast changes that have been brought about, let us consider how matters stood about a hundred and sixty years ago, say in 1754, the year in which our Society of Arts was founded. At that date the steam-engine had not yet assumed a practical form, and apart from some small use of water and wind power, when mechanical work had to be done this was accomplished by the aid of the muscular effort of men and animals. The question of power supply was, in fact, in the same condition that had existed for thousands of years, and, in consequence, the employment of machinery of all descriptions that required power to drive it was extremely limited. Nor as regards travel for persons, or transit for goods, were things very different. The steamship was unthought of, and ocean journeying was no faster, and but little more certain, than in the days of Columbus. Railways in the modern sense were non-existent, and even the coaching era had scarcely begun. Travelling of all sorts was no more rapid or more convenient than in the days of the Romans. Indeed, emperors such as Hadrian and Severus, who visited this country in late classical times, probably made the journey to and from Rome quite as expeditiously, and very likely even much more comfortably, than did any traveller of the eighteenth century. Furthermore, at the time of which I speak, the communication of intelligence was limited to the speed at which postmen could travel, for, of course, there were no electric telegraphs, such as have shortened the time of communication with the ends of the earth to a few seconds, and have reduced even ambassadors to the status of clerks at the hourly beck and call of the Home Government. In the eighteenth century, moreover, illuminating gas and electric light had still to be invented, public lighting was practically non-existent, and even in London and other large cities linkmen with torches were required to light the passenger to his home after dark. If printing was in use it was slow and expensive, without any of the modern mechanical, photographic, and other adjuncts that have rendered possible our numerous newspapers and the other derivatives of the press. Nor were there any proper systems either for water supply or for the disposal of sewage. Disease, born of filth and neglect, stalked through the land practically unchecked. Medicine was still almost entirely empiric. Little or nothing was known of the causes and nature of illness, of infection by bacilli, or of treatment by inoculation. Anæsthetics had not yet been applied, and the marvels of modern surgery were undreamt of. It would be easy to multiply instances, but in the aggregate it is not inaccurate to state that at the time this society was founded the general mode of life had not much improved on what obtained in civilised Europe in the days of the Antonines, while, in some respects, it fell much short of this.

To-day we live altogether in a different world, in an age of travel accelerated by steam, petrol, and electricity; of railways on the level, overhead, and in tubes; of trams and motor omnibuses, of bicycles and motor-cars; of steel ships and steel bridges; of mills and factories, with their products of every possible description; of telegraphs by wire and wireless; of telephones; of hourly newspaper editions and tape machines; of electric light indoors and outside; of electric power for every purpose, from carrying us upstairs to brushing our hair and our boots; of gas fires and gas cookers; of electric bells and electroplate; of automatic machines and thermos flasks; of pianos, pianolas, concertinas, and gramophones; of kodaks, snapshots, and kinematographs; of fountain-pens, sewing-machines, typewriters, lawn-mowers, knife-grinders, vacuum cleaners, and barographs; of cigarettes and lucifer matches, which are much newer than many people think; of innumerable new and cheap textile fabrics; of plate-glass, aluminium, indiarubber, celluloid, vulcanite, and all manner of new artificial materials; of laughing-gas for having a tooth out, of chloroform and ether for more serious operations; of X-rays for inspecting our interiors; of dozens of new medicines for every ailment, and ailments with new names discovered every day; of balloons and aeroplanes, in which we may all soon be travelling; besides all the masses of diverse machinery used in manufacture, in agriculture, and in the arts. All these things, as well as many more, are younger than our Royal Society of Arts.

It has been the fashion to divide what we understand by science into two portions, pure science and applied science; but these are only halves of one great whole. Pure science, which is the domain of the research worker and the discoverer, supplies the data, physical, chemical, and mechanical, which it is the function of applied science to turn to account for practical utilitarian purposes. For this latter operation are required the services of the inventor and the engineer, and other experts of a similar character.

Even great scientific discoveries have in some cases been made by chance, but generally only by men of marked intuition and acutely developed powers of observation. More often they have been the result of prolonged thought and of laborious and patient investigation, with delicate experiments. Many have been the issue of elaborate mathematical reasoning. As subjects become more complex, complete knowledge of what has been done before in the same field is more and more necessary. One of the most fruitful sources of new discovery in all branches of science in modern times has been the greater attention paid to quantitative as against merely qualitative research, very accurate measurements of every kind being one of the special features of present-day research methods. A noteworthy point is that the results of research are cumulative, one discovery almost invariably leading to others in course of time.

As a matter of experience all discoveries in pure

science, however recondite and however seemingly useless at the moment, find their practical application sooner or later. It may not be for years or even for centuries, but in its own time the application comes. Invention is a faculty of the imagination, the inventive temperament being akin to the artistic temperament, and real inventors, like true artists, being born and not made. In order to be great both must have creative powers in a high degree. Unless gifted at birth with the inventive afflatus, the ordinary man can no more by taking thought make himself an inventor than he can add a cubit to his stature. At the same time, the inventor, to be fully successful, must be suitably educated. By study and the acquisition of knowledge he widens his scope, and can apply his gifts in fields of invention to which, without such knowledge, he could not hope to aspire. This notwithstanding, it is a noticeable and curious fact that many great inventions have been made by men whose ordinary vocations were quite outside the particular field in which their inventions applied. This is no doubt a case of the fresh mind of the outsider looking at things from a new aspect, whereas those who are daily working in any particular line are apt to get into a groove and to be trammelled by usage and convention. Perseverance, and a capacity for continuity in keeping to one subject, are outstanding qualities to be observed in all successful inventors. Many with brilliant ideas fail for lack of these. As has been justly said, great discoveries are never, and great inventions very seldom, the work of a single individual.

At certain periods the general state of progress, both in pure and in applied science, renders particular inventions possible, with the result that a number of persons gifted with the necessary imagination almost simultaneously attack the problem. In such cases, if one individual inventor had not succeeded, it is probable that another would have done so, though perhaps in some slightly different manner.

For these reasons in all these cases it is very difficult, if not impossible, justly to apportion the credit. The public and the Press usually award it all to the individual who makes the first practical and commercial success, being entirely ignorant of all the previous stages that have led up to the final result, and oblivious of the fact that, without the vast amount of previous research by other workers, the final inventor would never have had the data wherewith to achieve what he did.

On the other hand, a contrary and equally mistaken view is not seldom taken by the workers in pure science, who, absorbed in the intricacies of their own achievements, are prone to underrate what the actual inventor accomplishes, usually by slow degrees, and with infinite pains and patience. They, further, do not understand what a long step there is between the mere idea and the worked-out invention, and how much labour, practical ingenuity, and perseverance, and also how much money an invention usually requires to make it successful and to get it taken up industrially. Indeed, this last-mentioned commercial operation is frequently the most difficult of all to bring about, particularly as it is not common for inventors to be good men of business.

The history of particular inventions is frequently instructive, and a good instance is that of wireless telegraphy, which is comparatively recent, so that we know all about it, and can follow accurately each single step in its development.

It, moreover, shows how pure and applied science are indissolubly interwoven, and how the one is dependent upon the other.

According to modern views, enunciated in the first instance about the year 1807 by Thomas Young, light consists of undulations or wave motions in a hypothetical ultra-material substance, known as the æther, which is supposed to fill all space, permeating the solid earth, the planets, the stars, and all material objects, and reaching to the utmost limits of the universe. Just as sound is known to be a wave motion in the air, so light is believed to be a wave motion in this hypothetical æther. About the year 1870 James Clerk Maxwell, professor of physics at the Cavendish Laboratory at Cambridge, chiefly by mathematical reasoning, showed the close connection between electricity, magnetism, and light by demonstrating that all three could be explained on the basis of motions and stresses in the æther. Thus, according to Maxwell, light was an electro-magnetic phenomenon, and consisted of disturbances in the æther of exceedingly short wave-length, whereas longer waves and stresses in the same medium explained the phenomena of electricity and magnetism.

As mentioned, Clerk Maxwell's discovery lay purely in the land of theory, discovered mathematically, and he attempted no experimental proof. Some twenty years later Heinrich Hertz, by a series of most beautiful experiments, proved the truth of Maxwell's theory. By means of suitable apparatus he first of all created electro-magnetic waves, and then with other apparatus he detected them, showing that they could be reflected and refracted, and, in fact, obeyed all the laws with which light is known to comply. Indeed, so completely was this accomplished that, on hearing of it, Lord Kelvin exclaimed that Hertz had annexed the whole science of optics to the domain of electricity.

Up to this stage nothing in these investigations had hinted even in the slightest degree at any useful application. Neither Young, nor Maxwell, nor Hertz was moved by any other ambition than a curiosity to explore the nature of things. On the other hand, had it not been for their labours, what was to follow could not possibly have occurred.

Hertz died young, almost immediately after making the experiments to which allusion has been made, but his work was taken up and largely extended in this country by Sir Oliver Lodge. Hertz's experiments had been on an exceedingly small scale, while Lodge employed, for creating his waves, methods which gave a much greater power; moreover, as a detector of these waves, Lodge used an exceedingly delicate instrument, which he christened the coherer. This was due to a discovery by Branly, of Paris, who also was investigating Nature without any ulterior utilitarian aims.

Lodge, no doubt, was impelled by similar motives, but having a practical mind he threw out the suggestion that the Hertzian waves might possibly be employed for signalling. Indeed, he went so far, at a lecture which he gave at the Royal Institution in 1894, as actually to ring a bell by this means from one end of the building to the other, through the thickness of several partition walls. In the same year, at the British Association meeting at Oxford, he transmitted similar signals over yet greater distances.

These experiments of Lodge led several persons to consider whether the method was not applicable to telegraphy, but nothing practical was done until Mr. Marconi, who was acquainted with the work of both Hertz and of Lodge, and was impressed with the possible commercial value of the idea, came upon the scene, and with great skill very soon showed that it was feasible by Hertzian waves to telegraph across the Channel, and even over much longer distances.

The rest of the history of wireless telegraphy, very interesting though it is, does not concern us here, for what I wish to impress upon you is how, in this instance, as in many others, researches and experiments in pure science, which, so far as their authors could see, showed not the faintest sign of any practical application, led in time to inventions of the greatest possible public utility. Many years elapsed between the researches and theories of Young and Maxwell, the

experiments of Hertz, and the advent of practical wireless telegraphy, and when it came all the three original investigators were dead; yet, unless these three great men had evolved their brilliant ideas and worked them out as they did, wireless telegraphy had never been. How difficult it is for the uninitiated to realise the importance and the practical potentialities of some discoveries in physics at the moment of their birth may be made plain by a few words about the remarkable developments that have taken place during the past few years in that department of science known as molecular physics. Up to comparatively recently the theory of the atomic structure of matter, and the idea of the indestructibility of the atom, that smallest material particle that was thought possible to exist, still held its own. First enunciated more than two thousand years ago by the Greek Democritus, developed later by another Greek philosopher, Epicurus, and popularised by the Roman poet Lucretius in his celebrated poem, "De Natura Rerum," this theory of matter was put on a proper scientific basis by the English chemist Dalton rather more than one hundred years ago. Quickly following the discovery of the X-rays by Prof. Röntgen in 1895, and of radio-activity by Prof. Becquerel a few months later, came a most surprising development—indeed, one of the most remarkable in the whole history of science. Mainly owing to the labours of Sir Joseph Thomson and his Cambridge school of experimenters, starting from the previous researches of Sir William Crookes, we now know that the atoms, once called the ultimate atoms, so far from being the indivisible entities as was once thought, are, each individual one of them, something very like a complete solar system, comprising a positively electrified sun or nucleus and a number of negatively electrified electrons or planets. More than this, though the whole atom is so small that it is quite invisible to the most powerful microscope, and that it would take at least three million atoms, perhaps ten or twenty times as many, set close together in a straight line, to cover a single inch, the constituent electrons are so much smaller that, though contained within the compass of the atom, they are as distant from one another, relatively to their size, certainly as are the earth and the moon, and possibly as the sun and the planets. The imagination reels at such an illustration of the microcosm of the infinitely small, just as it reels at the macrocosm of infinitely large astronomical space and its population of innumerable stars; but in Nature, as has been truly said, the adjectives "large" and "small" have no meaning. In Nature there is nothing absolutely great, and there is nothing absolutely little. Whether it be a matter of the dimensions of space or of the lapse of time, all is relative. To us humans space is measured in terms relative to the dimensions of our bodies, time in periods relative to the duration of our lives. To us things appear large or small, periods long or short, but these are appearances only, and have no absolute reality.

Now to those who have not studied the question all this must seem very remote from the practical politics of applied science, such as we make use of in our daily life. But it is not so, for it is to these almost infinitely small negative electrons that we owe the Röntgen rays. When propelled at the incredible velocity of something like fifty thousand miles per second, which they attain under electrical stimulation inside a Crookes vacuum tube, and caused to bombard a piece of metal, they create these rays in much the same way as the bullets from a machine-gun may rattle on a target and thus create sound. The Röntgen rays themselves are a description of light which, until artificially produced by man in the manner described, had never been observed in Nature, and, indeed, had perhaps never previously existed in the whole history of the universe. Their practical utility is, however, now universally realised, and in surgery and medicine they are in everyday demand.

Now, not only have these abstruse and seemingly quite academic discoveries about the electrical structure of the atom, and the properties of its constituent parts, brought about great improvements during the last few years in the design and use of Röntgen-ray tubes, but they have also borne practical fruit in other directions, as, for instance, in what is to-day much the most sensitive and trustworthy apparatus for receiving wireless telegraph signals. Their further utility, moreover, is just now beginning to make itself apparent, and quite recently they have been applied by Sir Joseph Thomson to an entirely novel form of chemical analysis, the possibilities of which it is as yet too early to estimate. Anyway, we see how in a space of only about twenty years discoveries of apparently purely academic interest, in perhaps the most abstruse of all lines of scientific investigation, are already beginning to be usefully applied. We see how the function of science to be utilitarian obtains just as much in the case of highly recondite investigations as in those that are more simple and in which the practical applications are more obvious.

It is impossible to study the history of civilisation without recognising that scientific research and invention, with their innumerable and incalculable actions and reactions, constitute the soul of industrial progress. Consequently, if this progress is to be maintained, every inducement must be provided to encourage those who are capable of carrying on the work. Since the beginning of the world it is not to the masses, but to the few exceptional individuals that all great advances have been due, and it is greatly to be deprecated that politicians, who must, or, at any rate, should, know better, continue to flatter the so-called working-man by telling him that he alone is the creator of wealth. To those who know the facts such a suggestion is, of course, absurd. Still, it is highly necessary that the masses should be educated to learn that unless those who have the requisite capacity are afforded the necessary leisure and facilities to work at research and invention, industries can be neither developed nor even maintained in the face of the world's competition, and that the working-man himself will be the principal sufferer from the resulting stagnation and decay.

It is unfortunate that in this country of late years it has become a fashion to consider the making of large profits as almost a crime, for the working out of many industrial scientific processes and inventions can be accomplished only by great and prolonged expenditure and the risking of vast sums of money, such as only very rich persons or companies can afford. The history of the fine chemical trade in Germany for some years before the war is a good case in point. Here very large sums were in some instances spent on the development of special processes. In many cases the money was lost, but the few speculations of this nature that succeeded recouped all that had been spent on the others, a single product in some instances bringing in an enormous net annual profit. This, again, enabled other similar problems to be attacked. With our system of taxation—income tax and super-tax, and now excess profits tax in addition, and the jealousy and outcry that the making of large profits engenders—it is very difficult to arrive at such results in this country, and this undoubtedly is one of the main reasons for our backwardness in diverse directions. A remedy should be found in exempting from taxation all money spent in new scientific developments. Otherwise, with stinted resources, we cannot expect to maintain our position.

Another point in connection with invention is the injustice and the inexpediency, from a public point of view, of the present system whereby the Patent Office makes a large annual profit out of the fees paid by inventors. There might possibly be some justification for this were the money thus obtained spent on scientific education, on provincial scientific libraries, or on some other object that would further invention and discovery. The money is, however, merged in the ordinary revenues of the country, and thus becomes a veritable tax on brains. It is, moreover, a tax on the cerebral activity of a class of men who are usually by no means overburdened with wealth. Though all inventors are fortunately not driven by poverty to such expedients as Palissy the potter, who actually had to burn his household furniture in order to provide heat for his furnace, still the majority of inventors are undoubtedly poor, and find the cost of protecting their inventions by patent, and still more of maintaining these patents when granted, a considerable strain upon their finances. The truth of this may be seen by the frequency with which patents are dropped merely in order to save the renewal fees, and the patentee in some cases deprived of profits to which he is justly entitled.

We shall, however, never get justice done to science by the Government and its departments until some knowledge of science is made a compulsory part of the curriculum for the training of the Civil Service and an important item in the entrance examinations. Only in this way shall we get the departments filled by men who realise what science means, and how it lies at the root of all material progress. There is an idea afloat in the political world, as also in the bureaucratic mind, that no man can at the same time be a master of science and a good administrator or organiser, either in public or commercial affairs. This idea probably originated from observation of scientific men of the scholastic and professorial types, whose training has been mainly directed to the art of teaching, and who have never had much opportunity of developing their faculties in the administrative sphere. To show, however, how false is the assumption, it is only necessary to mention two such names as those of Benjamin Franklin and Count Rumford, both of whom were consummate men of science and did very valuable original scientific work, but were also both prominent men of business and managed great political undertakings with remarkable success. Or, if we come to more modern times and turn to captains of industry, there are, without going out of this country, and to mention only one or two, such men as Joseph Whitworth, Henry Bessemer, William Armstrong, and Andrew Noble, all of whom had high scientific gifts and knowledge, and also were very successful in the organisation and administration of large industrial enterprises. Indeed, for any business employing technical methods the ideal chief must necessarily be a man of scientific attainments, as it is only such a one who can properly weigh the pros and cons of the propositions put before him by his technical staff, while, what is even more important, it is only such a chief who can command the real respect of his employees, who will never have complete confidence in, or a proper veneration for, a leader whose scientific and technical knowledge and experience are in the aggregate less than their own. These considerations, of course, apply to Government departments which deal with scientific questions equally with industrial undertakings carrying on technical processes or manufacture.

In obtaining Government support for the promotion of applied science, it is most necessary to beware of political interference.

The dangers that arise from this may be seen from the history of one or two typical industrial applications of science during the last century. Take, for instance, the application of mechanical power to road locomotion. In the period covered by the years 1820 to 1836 this made rapid strides, and towards the close of the period many steam-coaches were maintaining regular services between various centres in different parts of the country. In this, England was many years ahead of the rest of the world, and a new and what promised to be a very profitable industry was being developed. Parliament, however, at the instance of rival interests, passed hostile legislation which absolutely shut the whole movement down, and automobilism in this country was completely crushed, not to be heard of again for more than fifty years. When, moreover, a new beginning was made, the fresh start did not take place in England, its original home, where it was prohibited by law, but in France, where legislation was more enlightened. In this way, owing entirely to the politicians, we lost an opportunity of becoming pioneers throughout the world of a completely new and what proved to be a gigantic industry, which might have brought to our manufacturers much wealth and to the working classes much lucrative employment.

Or, to turn to another case, take the history of electric lighting and of the supply of electric power. Here, again, the development of a new scientific industry was greatly impeded by Parliamentary action. In 1882 this country was as far advanced in everything pertaining to the application of electricity as any other country on the globe. Indeed, many of the developments in this branch of science were peculiarly British, having originated in this country. Again Parliament intervened, and with a mistaken idea of protecting the consumer from the dangers of monopoly, so effectually strangled the whole movement that for six years there were practically no consumers at all, as the conditions imposed on undertakers were so onerous that no one would risk the money required to institute a supply. In 1888 the political powers that were, realising their mistake, made some legislative amendments that enabled a start to be made; but it was then too late, for other countries had got ahead, and even then the electrical industry was still hampered by artificial conditions, some of which endure to the present day, with results that have been inimical to proper development. There are other similar instances, such as the telephone, in regard to which the politicians have interfered to the detriment of progress.

To a society such as this, the object of which is the encouragement of the arts, science is mainly interesting from its pre-eminent value for purely materialistic ends, and it is therefore from this point of view that I have endeavoured to give some account of its functions. It must not, however, be supposed that science has not also a very high value from the ethical point of view. As Adam Smith wrote in his "Wealth of Nations" nearly a century and a half ago, "Science is the great antidote to the poison of superstition"; moreover, science is, so far as the limitations of the human intellect will permit, a search for absolute truth. Accuracy is its foundation-stone, acute observation and strict logic are its most powerful agents. These have all an educational value of the highest importance. The study of Nature and the pursuit of knowledge have, in addition, an elevating influence, and produce a breadth and a strength of mind that rise superior to material environment. This is well seen in the blameless lives of the great masters of science, and in the way that many of them sacrificed everything to their work. Some encountered persecution and even martyrdom for their ideas, and met their misfortunes with a fortitude quite equal to that shown by other men for their faith. Among the functions of science we must not therefore forget its moral power.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE geophysical discussions arranged by the Geophysical Committee of the British Association on November 7 and December 5 were well attended and very successful. The meetings will begin again in February, and will continue until June inclusive. At the February meeting Dr. A. Strahan will be in the chair, and the speakers will be Col. Close, on the effect of variation of barometric pressure on mean sea-level, and Major Henrici, on precise levelling. At the March meeting Sir Napier Shaw will be in the chair, and Prof. H. H. Turner will open a discussion on seismology, in which it is expected that Mr. G. W. Walker and Mr. R. D. Oldham will take part.

MR. BERTRAND RUSSELL's lectures on the "Philosophy of Mathematics," at Dr. Williams's Library, Gordon Square, W.C.1, have been so successful that a second course, to be given after Christmas, has now been arranged. The new course will be quite distinct, and, like the present, will be designed to expound the logical basis of mathematics. The lectures presuppose no special mathematical training, and technical terms and symbols are dispensed with. The present course, which concludes on December 18, has dealt with the more specially mathematical questions. The new course will be devoted to philosophical problems, and Mr. Russell will expound his theory of logical atomism. The lectures are on Tuesday evenings at 5 o'clock; they will begin on January 22.

MR. ASQUITH, in his address in the Town Hall, Birmingham, on Tuesday, December 11, at a meeting promoted by the National War Aims Committee, referred to problems of reconstruction, and is reported by the *Daily Telegraph* to have said:—"In regard to these matters, you will not be surprised if I put in the forefront, as of paramount importance, a comprehensive rebuilding, and a far more adequate equipment, from the very bottom to the very top, of our system of national education, of which the Bill introduced by Mr. Fisher gives the hope, and, indeed, the promise. To put it from the lowest and most material point of view, it is largely, indeed mainly, through our educational deficiencies that we have either lost or never established some of those basic industries which no great country can afford to be without. The future relations of employers and employed will have to be readjusted, starting from the proposals, which I believe to be in spirit and principle almost universally accepted, of the Whitley Report, with developments for securing greater elasticity, more representative authority, and a more vital contact with new conditions, in the organisation of both; and, above all, with the purpose of achieving for men, women, and children opportunities, which were never given them under the old factory system, for a freer, a more self-developed, a humaner life."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 6.—Sir J. J. Thomson, president, in the chair.—Prof. W. H. **Young**: The series of Legendre.—L. **Hartshorn**: The discharge of gases under high pressures. It is well known that when gas discharges through an orifice from a vessel in which the pressure is p_0 into one in which it is p_1, the rate of discharge is approximately constant from $p_1=0$ upwards to some critical value, but then, as p_1 further increases, the discharge falls off, slowly at first, afterwards with greater rapidity. In the present investigation, this phenomenon is examined with greater accuracy than has hitherto been obtained. In every case it was found that the flow was constant to at least one part in 10,000 for a considerable range of p_1. The critical value of p_1, at which the flow began to change, varied widely for different nozzles, being about $0{\cdot}2\ p_0$ for the convergent and parallel ones, but as high as $0{\cdot}7\ p_0$ for certain divergent ones. Thus, the theoretical value for convergent nozzles, viz., $0{\cdot}527\ p_0$, cannot be accepted as applying even approximately to all nozzles.—Lt.-Col. A. G. **Hadcock**: Internal ballistics. This paper deals with the burning of the explosive in the gun and the expansion of the gas, both before and after the charge has been consumed. On firing the gun the action is threefold:—(1) The driving band on projectile is forced into the rifling grooves. (2) In subsequent burning of charge, the gas from any fraction of charge expands with consequent reduction of temperature. The still burning powder gives additional heat. The expansion is thus partly adiabatic and partly isothermal. (3) After the charge is consumed the gas expands adiabatically. From expressions given in the paper, and knowing the rate of burning of cordite under various pressures, formulæ are developed for finding velocity of projectile, position in gun, and pressure of gas. The magnitude and position of maximum pressure are found by a further development of formulæ.—Dr. A. **Russell**: The electrostatic problem of a conducting sphere in a spherical cavity. The author gives formulæ by means of which the capacity, the electric force between the spheres, and the maximum electric stress on the dielectric between them can be readily computed in all cases to any required degree of accuracy. The solutions of these problems are required when determining the ratio of the measure of the electrostatic to the electromagnetic unit of charge by means of a spherical condenser for the calibration of a spherical condenser of variable capacity, for the calibration of a high-tension voltmeter, and for the determination of the electric strengths of insulating materials.—Prof. G. N. **Watson**: The zeros of Bessel functions. The paper contains a statement and discussion of some general theorems concerning the zeros of Bessel functions; the theorems are true for functions of any order, and, unlike results previously known, are of particular interest in the case of functions of high order. It appears that comparatively general considerations of a non-arithmetical type yield fairly precise information concerning the position and numbers of the zeros of the Bessel functions of the first kind. It is doubtful whether results of this character could be obtained without making use of the method of steepest descents which has been prominent in various recent investigations.

Aristotelian Society, December 3.—Dr. H. Wildon Carr, president, in the chair.—F. C. **Bartlett**: The development of criticism. An attempt to trace broadly the development of criticism reveals four main stages—the simply appreciative, the conventional, the rational, and the intuitional. At the first, criticism is the immediate outcome of the feeling accompanying ease or hesitation of reaction; at the second, a situation or object is criticised by virtue of its relation to a mass of preceding experience, the latter remaining relatively vague and unanalysed; at the third, definite rules of criticism are developed; at the fourth, the verdict passed is regarded as the outcome, on one hand, of the peculiar nature of the object, and, on the other, of the relation of the object to the critic. Affective factors play a dominant part throughout in the production of criticism, while the direction of development is determined by a persistent "effort after meaning."

Mathematical Society, December 6.—Prof. H. Hilton, vice-president, in the chair.—Col. R. L. **Hippisley**: A new method of describing a three-bar curve.—O.

Hoppe: Proof of the primality of N = [illegible].—Messrs. **Hardy** and **Littlewood**: New Tauberian theorems.—C. V. H. **Rao**: The curves which lie on the quartic surface in space of four dimensions, and the corresponding curves on the cubic surface and the quartic with a double conic.—Prof. W. H. **Young**: (1) The connection between Legendre series and Fourier series. (2) Series of Bessel functions.

PARIS.

Academy of Sciences, November 26.—M. Camille Jordan in the chair.—G. **Humbert**: The development of irrational quadratics in a Stephen Smith continued fraction.—H. **Le Chatelier** and B. **Bogitch**: Silica bricks were prepared with different proportions of large quartz grains (4 mm.), and fine (0·1 mm.) or alternatively impalpable (0·01 mm.) quartz powder. The resistance to crushing of the silica bricks was determined at 1600° C., and cold. The substitution of fine quartz for impalpable reduced the strength at 1600° C. in a very marked manner; 75 per cent. of quartz grog to 25 per cent. impalpable quartz powder, with 2 per cent. of lime as cement, gave the best results. The crushing resistances of silica bricks, measured cold, do not necessarily correspond with the resistances measured at 1600° C.—E. **Perrier**: The exchanges of fauna between the sea and fresh water and the consequences from the point of view of sexuality.—E. L. **Bouvier**: The distribution of fresh-water crabs of the family of the Potamonidæ.—C. **Guichard**: The C networks such that the Laplace equation which corresponds with them is integrable.—P. **Humbert**: Expression of the Legendre function of the second species.—F. **Ventre**: Theorem on rolling loads.—Mlle. Y. **Dehorne**: The microscopic constitution of the skeleton of the Stromatoporidæ.—J. **Feytaud**: The parthenogenetic reproduction of *Otiorhynchus sulcatus*.—A. **Vernes**: The precipitation of colloidal ferric hydroxide by human serum, normal or syphilitic. If human serum is added in gradually decreasing quantities to the same amount of colloidal ferric hydroxide, with subsequent digestion at 37° C., at first there is no flocculation, then for a certain concentration of the serum there is complete flocculation. The phenomenon is periodic, decreasing amounts of serum giving alternately flocculation and no flocculation. With syphilitic serum the results are different, and it is possible to prepare a fine suspension of a determined stability which will flocculate with a certain amount of syphilitic serum, but will not flocculate with the same amount of normal serum.—J. **Ducuing**: The publication of MM. Heitz-Boyer and Scheikevitch concerning the *rôle* of bone in osteogenesis in the adult; the relations of osteogenesis with infection, and the corresponding applications.

BOOKS RECEIVED.

My Four Years in Germany. By J. W. Gerard. Pp. xiv+320. (London: Hodder and Stoughton.) 7s. 6d. net.

Il nostro Soldato. Saggi di Psicologia Militare. By A. Gemelli. Pp. xii+339. (Milano: Fratelli Treves.)

Report on Agricultural Damage by Vermin and Birds in the Counties of Norfolk and Oxfordshire in 1916. By R. T. Gunther. Pp. 92. (London: Oxford University Press.) 2s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 13.

ROYAL SOCIETY, at 4.30.—The Formation of Nitrites from Nitrates in Aqueous Solution by the Action of Sunlight and the Assimilation of the Nitrites by Green Leaves in Sunlight: Prof. B. Moore.—The Transition from Rostro-carinate Flint Implements to the Tongue-shaped Implements of River-terrace Gravels: J. R. Moir.

LINNEAN SOCIETY, at 5.—Seeds with a Stony Endocarp and their Germination: A. W. Hill.—*Inter se* Experiments in Pheasant Crossing in evidence of Mendel's Law: Mrs. R. Haig Thomas.

ROYAL SOCIETY OF ARTS, at 4.30.—The Trade of India with Russia, France, and Italy: D. T. Chadwick.

OPTICAL SOCIETY, at 8.—Proposed Standard Optical Notation and Sign Convention: J. W. French.—Optical Nomenclature and Symbolism: T. Smith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on the Metric System. Introductory Papers by L. B. Atkinson and A. J. Stubbs.

FRIDAY, DECEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) The Determination of Photographic Magnitudes. II.; (2) Prof. Sampson's Note on the Southern Magnitude Distribution: J. Halm.—The Classification of Long-Period Variable Stars: H. H. Turner.—The Resonance Theory of the Origin of the Moon: H. Jeffreys.—Variations in the Fourteen Months' Component of the Polar Motion: Hisashi Kimura.—Further Notes on the General Solution of Hill's Equation: E. Lindsay Ince.—The Errors in a Sum of Tabular Quantities: H. C. Plummer.—*Probable Paper:* The Short-Period Variable RZ Cephei: C. Martin and H. C. Plummer.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—The Use of Soap Films in Solving Torsion Problems: A. A. Griffith and G. I. Taylor.

MONDAY, DECEMBER 17.

ARISTOTELIAN SOCIETY, at 8.—The Conception of Reality: Dr. G. E. Moore.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Drift of the *Endurance*: 2nd Lieut. J. M. Wordie.

ROYAL SOCIETY OF ARTS, at 4.30.—Progress in the Metallurgy of Copper: Prof. H. C. H. Carpenter.

VICTORIA INSTITUTE, at 4.30.—The Mosaic Origin of the Pentateuch: Rev. A. H. Finn.

SOCIETY OF ENGINEERS, at 5.—High-speed Railways: E. W. C. Kearney.

TUESDAY, DECEMBER 18.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Buenos Aires Western Railway Tunnels under the City of Buenos Aires: W. L. L. Brown.

ROYAL STATISTICAL SOCIETY, at 5.15.

ILLUMINATING ENGINEERING SOCIETY, at 5.—Presidential Address: A. P. Trotter.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Prospective Oil-fields of Barbadoes: E. H. C. Craig.

WEDNESDAY, DECEMBER 19.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Computation of Wind Velocity from Pilot-Balloon Observations: P. Bolton.—The Use of Monthly Mean Values in Climatological Analysis: E. G. Bilham.

ROYAL SOCIETY OF ARTS, at 4.30.—Science and the Cold Storage Industry Prof. J. Wemyss Anderson.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Cytology and Genetics: Prof. W Bateson.

THURSDAY, DECEMBER 20.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—A Neglected Chemical Reaction and an Available Source of Potash: E. A. Ashcroft.—Syphoning Gravel: J. Jervis Garrard.

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THE TUBERCULOSIS PROBLEM.

The Causes of Tuberculosis, together with Some Account of the Prevalence and Distribution of the Disease. By Dr. Louis Cobbett. (Cambridge Public Health Series.) Pp. xvi+707. (Cambridge: At the University Press, 1917.) Price 21*s*. net.

THE physician, the teacher, the administrator, or the member of the Public Health and Hygiene Committee, though he has had at his disposal innumerable text-books, papers, pamphlets, reports of Commissions, Blue Books, and the like, has up to the present had access to no well-digested account of the cause, course, and prevention of tuberculosis, a subject of vital importance to the community.

In writing a logical and well-balanced account of the observations and opinions of others, vitalised by an interweaving of the results of his own wide reading and personal investigation, Dr. Cobbett has done much to fill this gap.

After serving as one of the scientific investigators to the Royal Commission on Tuberculosis, Dr. Cobbett evidently extended his experience of the pathology of tubercular phthisis in a large industrial centre, Sheffield, where this occupational disease is one of the main factors in the morbidity and mortality bill of the town. He had thus an almost unique training, of which we now reap the fruits. His experience of experimental work and its pitfalls, and his acquaintance with the difficulties that face the practical sanitarian and those who are engaged in the treatment of tuberculous patients, enable him to bring to bear a keen critical faculty on the experience and experiments of other investigators, with the result that the work now before us may be looked upon as a "classic," and one that for years to come will, probably, remain the reference-book for those interested in tuberculosis.

The first three chapters, dealing with the incidence, the mean annual mortality, and the decline in mortality from tuberculosis, have already been dealt with by Dr. Cobbett in a series of lectures. For the public health authority and the slum reformer this section—forty-five pages only—will be invaluable.

After brief notes on the etiology of tuberculosis and on the discovery of the tubercle bacillus, the investigations of the Royal Commission on Tuberculosis, of Weber and his colleagues at the Kaiserliche Gesundheitsamt in Germany, of the Bureau of Animal Industry in the United States, and of French, Belgian, and Dutch workers is subjected to critical examination and most impartial summarisation. The evidence of infection and of the importance of "massive" infection in the production of disease, the mass varying with different species of animals and the type—human, *i.e.* naturalised in the human subject; bovine, naturalised in the bovine animal; and avian, the form of bacillus naturalised in, and specially infective for, birds—are in turn dealt with, first in relation to tuberculosis as it occurs in various animals, and then in relation to the production and spread of the disease from these animals to man. After a discussion of the portals of entrance of the infective material, one of the most closely reasoned sections of the book, interesting observations as to the infectivity of the different types of tubercle bacilli on the various animals, (*a*) naturally, (*b*) as the result of experiment, are recorded. From these it is evident that many animals which, owing to their conditions of life, appear to be exempt from "spontaneous" tuberculosis are comparatively easily infected "experimentally." Spontaneous tuberculous infection of the guinea-pig is so rare as to be almost non-existent, but to infection by bacilli of both human and bovine type it is extremely susceptible; whilst the cat, which appears to be specially susceptible to infection by the "bovine" tubercle bacillus, appears to be far more refractory to the "human type" of bacillus.

As the result of the combined experience of the workers dealt with in this book, it is laid down that the tubercle bacillus of bovine type is present in, and the cause of, the lesions of the ox, pig, goat, sheep, horse, camel, cat, dog, monkey, and man, in whom, in addition to the ordinary type of bovine bacillus, a modified form is found in cases of lupus. The avian type of bacillus, found especially in domesticated birds, has also been demonstrated in the rabbit and pig, and in rats and mice coming in contact with these birds. That it plays little, and certainly no important, part in the production of human tuberculosis is generally accepted. The "human type" of tubercle bacillus, in addition to occurring in man, where it is found in the lung and in a modified form in cases of lupus, occurs in the dog, giving rise to about half the cases of tuberculosis in that animal, and in the localised glandular tuberculosis of the pig. It has also been found in captive monkeys, in caged parrots, and in certain mammals—antelope, elephant, and lion—kept in captivity.

Dr. Cobbett, in his earlier chapters, maintains that the human type of tubercle bacillus is responsible for 94 per cent. of the fatal, mainly pulmonary, cases of tuberculosis in man, the remaining 6 per cent. being caused by the bovine bacillus. (In an appendix, as the result of the consideration of more recent investigation on tuberculosis of bones and glands, there is evidence of modification of this opinion.) Of the non-fatal cases of tuberculosis, however, the bovine bacillus is responsible for a much larger proportion—about 50 per cent. Infection with the bovine bacillus is commonest in infancy, uncommon after five years of age, and rare in adult life. It is associated specially with tuberculosis of the alimentary tract and the associated glands, but bovine bacilli have undoubtedly been isolated from a number of cases of pulmonary tuberculosis. In Scotland, and especially in Edinburgh, the bovine bacillus appears to play a more important

part than it does elsewhere in Great Britain or abroad, and the differences of opinion that from the first existed between Koch and those Scottish investigators whose material was obtained in Edinburgh are thus, in all probability, accounted for. This is a matter of great importance and continues to receive attention.

Dr. Cobbett, in summing up, contends that the "bovine bacillus" is less virulent than the "human bacillus" for man, man in this respect differing from all other animals, "for, with the exception of the apes and monkeys, which are equally susceptible, and the dog, which is equally resistant to either type, all other species, so far as is known, are more severely affected with the bovine than with the human bacillus."

Finally, Dr. Cobbett concludes (1) that the importance of tuberculosis is not to be measured only by the deaths caused—above 50,000 per annum in England and Wales alone, mostly "in the prime of life or only a little earlier"—but that, "in addition to these deaths, tuberculosis produces a great number of cripples"; (2) that during the last fifty years "the number of deaths caused each year by tuberculosis has diminished steadily and substantially, and the ratio of deaths to population has fallen by more than 50 per cent.," that it is still declining rapidly "and at an ever-increasing velocity."

In a series of appendices a number of interesting details concerning recent investigations are given. Of these one of the most important is the persistence of tubercle bacilli of human type in the tubules of the cow's udder once it has made its way, and gained a footing, there. This, with an account of the general dissemination of tubercle bacilli after subcutaneous injection, indicates the danger involved in the attempt to immunise milch cows against tuberculosis with living tubercle bacilli. A brief account of the later studies of the types of tubercle bacilli found in the lesions of bone and joint tuberculosis, by which Dr. Cobbett has been led to the conclusion that the percentage of bovine infections is considerably greater than set out earlier in the book, the percentage of bovine infections in England being 14·7 and in Scotland 29·6, is of considerable interest in that here we have a key to the value of the work before us—the extreme impartiality and open-mindedness of the author.

All who are interested in tuberculosis will be well repaid by a careful study—not merely a perusal—of this interesting work, a study rendered far easier by the numerous excellent photographs illustrating points to which the author wishes to direct special attention.

MATHEMATICAL PUZZLES.

Amusements in Mathematics. By H. E. Dudeney. Pp. viii + 258. (London: T. Nelson and Sons, Ltd.) Price 3*s*. 6*d*. net.

MR. DUDENEY is famous as a composer of puzzles of a semi-mathematical character, and for some years questions by him of this kind have appeared regularly in several English periodicals. He has now collected a large number of them, added a few new ones, and published the whole in book-form classified under various heads. The questions, more than four hundred in number, range over so wide a field that it is difficult to describe them succinctly, but usually they consist of brief statements, put in a picturesque form, of problems that might conceivably occur. Of these conundrums, some are variations of familiar puzzles, others are new, some are easy, others difficult, but, broadly speaking, all are interesting, and none can be answered without care and thought. In a few cases the point of the problem depends on the wording—a device open to criticism, though one which, in his preface, Mr. Dudeney explicitly defends. The solutions are given separately in the latter part of the book, and no one acquainted with Mr. Dudeney's reputation will need the assurance that they are ingenious and suggestive.

The author—wisely for his purpose—generally avoids lengthy discussions, but the permanent value of the work would have been increased had references to authorities who had treated questions analogous to those submitted been given more freely. For instance, the problem of arranging the twelve members of a bridge club for eleven days so that no two members play together as partners more than once and each member meets every other member as opponent twice is propounded, and Mr. Dudeney gives the bare answer; but there is no reference to Moore's paper of 1896 where the question for $4m$ players is discussed and the theory set out. Again, one "compass" construction is proposed, and the solution of the particular question is given; but a reference to Mascheroni's work of 1795 would have shown that there is a theory of the subject and put the reader on the track of scores of similar problems.

Interspersed in the text are some scholia on problems of particular types, with notes of methods for attacking them. These seem to us the most valuable part of the book, for collections of miscellaneous questions, once read, are not often looked at again; but comments on methods of solution and the past history of problems are of permanent interest. We should have liked to see further discussions of this kind, but with such a feast spread before us it would be ungracious to complain that more has not been given. In one of these scholia there are diagrams of some European labyrinths: Mr. Dudeney says he does not know of any instance of such a figure in an English church, so it may be pointed out that there is one, outlined in marble, on the floor of Ely Cathedral—probably it had not been laid down in 1858, when Trollope wrote his standard account of the subject. In the notes on magic squares there is mention of a transerial or doubly magic square of the eighth order, and it might well have been added that similar squares of higher orders are also known: the formation of such squares is, however, a difficult problem and not to be recommended to non-mathematical readers. In another scholium the digital treatment of

certain number-problems is discussed; we gather that this application is original on Mr. Dudeney's part. Digital properties are but little known to mathematicians, and we hope his example may serve to direct attention to the method: it was freely used by Bidder, the calculating prodigy, and in a certain class of arithmetical problems is of great assistance.

This notice will indicate generally the lines on which the book is written, and on the whole we should say that it is the best miscellaneous collection of the kind with which we are acquainted. The book is profusely illustrated, a marvel of condensation and cheapness, and singularly free from ambiguities and slips. It would be difficult to find a more attractive present for a schoolboy who is interested (as most schoolboys are) in such problems, for wherever he opens it he will find some amusing puzzle which will tax, and in many cases overtax, his ingenuity.

FOSSIL BOTANY.

Fossil Plants: a Text-book for Students of Botany and Geology. Vol. iii., *Pteridospermeae, Cycadofilices, Cordaitales, Cycadophyta.* By Prof. A. C. Seward. Pp. xviii+656. (Cambridge: At the University Press, 1917.) Price 18*s.* net.

In the present instalment of Prof. Seward's well-known text-book on fossil plants the interest of the subject may rightly be said to culminate. For this volume deals exclusively with the groups of fossil gymnospermous plants, and here between its covers the reader will find spread out for the first time in full and proper perspective the significant discoveries and results of the last fifteen years. The fossil Gymnosperms include the great central groups of seed-plants, and of these one-third of the book is devoted to a consideration of the Pteridosperms and their attendant Cycadofilices, another to the Cycadophyta, whilst the rest is divided between the Cordaiteæ and a long chapter on fossil seeds. This last feature is a most useful digest of a complicated mass of literature, and is a service that will be generally appreciated.

Modern advance, particularly as to the status of the Pteridosperms and the Bennettitales (Cycadophyta), has depended primarily on the study of petrifactions derived from Britain, France, and North America, whilst the knowledge thus obtained has been reinforced and extended by a critical consideration of impressions from which is gained a sort of twilight picture of these ancient vegetations. Prof. Seward possesses the indispensable qualification in the writer of a book like the present of a practical familiarity in handling both these sources of information—petrifactions and impressions—and when, in addition, the task is performed with such evident sobriety and good judgment, the result is a book of the greatest permanent value. It should be added that never before has the subject-matter of fossil botany received such full and connected treatment, nor could the marshalling of the facts be bettered.

In the treatment of his subject-matter the author, in large degree, lets the facts tell their own story. Whilst the theories of fossil botanists are adequately displayed, the author resists all temptations to speculate in the field of plant phylogeny. Nevertheless, apart from his own relevant researches, a good deal of unpublished matter is brought into this book, especially minor points collected from all quarters, each by itself, perhaps, insufficient to justify separate publication, yet in the aggregate appropriately included in a book like this.

Turning over the pages of this book, it is remarkable how large a share in the establishment of fossil botany has been taken by this country. Following the older period of description under Williamson came a newer epoch of critical redescription, with correlations of members previously scattered. With the momentary exhaustion of the English coal-balls of Palæozoic age, the interest passed to the Bennettitales from the American Jurassic rocks, once more to cross the Atlantic to Scotland, where new forms of great antiquity and interest are now coming to light. It is to be expected later on that a more intensive and scientific exploitation of our own and the world's coal resources will continue to produce a harvest of fossil plants rich enough to give full occupation to palæobotanists, and at the same time still further to elucidate the scheme of evolution of the vegetable kingdom.

In conclusion it is fitting to mention that this volume is dedicated by Prof. Seward to the memory of the late Prof. C. R. Zeiller, who for so many years was attached to the Ecole des Mines at Paris. Zeiller appealed to workers in this country not only by reason of his lofty character and eminence as a fossil botanist, but particularly because he, more than any other, established and promoted cordial solidarity between the ranks of fossil botanists on either side of the Channel. It is largely on this account that the recent severe and deplorable losses which the fraternity of palæobotanists has suffered in France (including, in addition to Zeiller himself, Lignier, Grand'Eury, and the elder Bertrand) have evoked in this country a wide and sympathetic response which only the loss of personal friends can arouse.

OUR BOOKSHELF.

With the French Flying Corps. By C. D. Winslow. Pp. 190. (London: Constable and Co., Ltd., 1917.) Price 3*s.* 6*d.* net.

This short volume contains the experiences of an American volunteer who joined the French Flying Service, and gives a brief account of the various steps of his training. The book can in no sense be called a scientific work; indeed, the use of technical terms is very loose, as, for instance, the definitions of angle of attack and angle of incidence given on p. 30. Statements such as that on p. 26 to the effect that "when two aeroplanes

are too near each other the suction of their propellers pulls them together, and they become uncontrollable," would certainly not command scientific justification. This technical inaccuracy does not detract from the interest of the book as a record of the actual experiences of an aviator during training and in flying over the enemy's lines. The greater part of the volume consists of such experiences and forms interesting reading. It is well that those who labour in the aeronautical world at home should have some idea of the actual fighting conditions at the Front, and the volume before us gives a very good account of the impressions of a pilot engaged in this thrilling phase of modern warfare. A detailed knowledge of the principles of flight is by no means necessary to enable a man to become an expert pilot, any more than a detailed knowledge of engineering is necessary to enable a man to ride a bicycle or drive a car.

The volume is essentially descriptive and non-technical, but it is, nevertheless, interesting to the scientific worker who wishes to obtain a mental picture of the actual conditions under which our airmen work, and of the wonderful part played by the aeroplane in modern warfare.

The Born Fool. By J. W. Byrd. Pp. 316. (London: Chatto and Windus, 1917.) Price 6*s*. net.

This is the record, in considerable detail, of the childhood and adolescence of an engineer and geologist who, born and moving in middle-class circles, convinces himself that it is his duty, on purely altruistic grounds, to marry a woman not only of lower social and intellectual status than himself, but also appreciably older. In parts the story is excellent (if this recalls the curate's egg, *absit omen*), and, despite some few *naïvetés* and trivialities—slight blemishes inseparable, perhaps, from the maiden production of any author—it is a very interesting study, abounding in natural touches and realistic incidents.

The atmosphere of the tale is to a large extent engineering and geological. The hero, at the age of twenty-one or thereabouts, becomes a fellow of the Geological "Institute," in consequence of a thesis of extraordinary merit and a discovery of unique importance. He also acts as resident engineer on water-supply undertakings of some magnitude. Precocity of this kind is, of course, not unusual in the realm of fiction. At the same time, the book envisages certain sociological, sexual, and religious problems in a way which will appeal to thoughtful minds, so that there is a wide and varied range of interest for many readers.

Quantitative Chemical Analysis. Adapted for Use in the Laboratories of Colleges and Technical Institutes. By Dr. F. Clowes and J. B. Coleman. Eleventh edition. Pp. xxiv+580. (London: J. and A. Churchill, 1918.) Price 12*s*. 6*d*. net.

This eleventh edition of this well-known work of reference has been carefully revised and new matter has been introduced in the Appendix. The results of typical analyses obtained in the laboratories of the authors occupy eleven pages, and will prove useful to analysts and others for reference and guidance; the list of important works of reference provided will also be equally serviceable.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Ramsay Memorial Fund.

We are asking the hospitality of your columns to enable us to report the progress of the Ramsay Memorial Fund, which was instituted just a year ago with the object of raising a sum of 100,000*l*. as a suitable memorial to the late Prof. Sir William Ramsay. The fund has now reached a sum of just above 30,000*l*. The latest and most important donation to the fund has been a sum of 5000*l*., contributed by Mrs. Wharrie. It may be remembered that Messrs. Brunner, Mond and Co. have promised a similar sum of 5000*l*. The honorary treasurers have received a large number of other sums, ranging from 1000*l*. to one guinea. From this it will be seen that the Ramsay Memorial Fund has now passed its experimental stage, and is making good progress towards the sum which the committee aim at raising. The Executive Committee are confident that with the assistance of the large number of co-operating committees which have been formed in all parts of the British Empire and many foreign countries they will be successful in completing the fund of 100,000*l*., but in order that this may be the case they must appeal to the generosity of the public for further donations, large and small. They hope that the generous example of Mrs. Wharrie and of Messrs. Brunner, Mond and Co. will be followed by others, but they will also greatly welcome gifts of any amount ranging from one guinea upwards.

The fund of 100,000*l*., when raised, will be devoted to two objects of great national importance: the establishment of Ramsay Memorial fellowships for research in chemical problems as applied to industry, and the foundation of a memorial laboratory of engineering chemistry. Those who contribute to the Ramsay Memorial Fund are contributing in the most definite and direct way to the national prosperity after the war, in which the advancement of science must play an increasingly important part. Donations should be sent to the joint honorary treasurers, Ramsay Memorial Fund, University College, London, Gower Street, W.C.1.

Rayleigh,
Chairman of the General Committee.
Hugh Bell,
Chairman of the Executive Committee.
Glenconner,
J. N. Collie,
Honorary Treasurers.

The Beginnings of Porcelain in China.

In the review of our publication by Dr. J. W. Mellor (Nature, October 4, p. 88) there is a misunderstanding which we feel should not be allowed to pass in the interest of your readers. Dr. Mellor states that we regard the so-called Han pottery as porcelanous, and as the forerunner of true porcelain. Such a statement has never been made; we always held, and still hold, that Han pottery is nothing but a common stoneware.

The pottery newly discovered in Shensi, and forming the subject of our investigation, is a distinct group, which, as maintained repeatedly, was not turned out under the Han, but long afterwards, at the end of the third century A.D. In its form and design it is a direct descendant of Han pottery, but its glaze, as proved by analysis, is porcelanous. For this reason it has been styled "Han porcelanous pottery."

Dr. Mellor mentions only the analysis of the green-glazed Han pottery, which has no connection whatever with the porcelanous material analysed. The body of this Han fragment is a coarse red earthenware, which can in no sense be considered porcelanous. Certainly the porcelanous body analysed does not appear porcelanous to casual inspection. The true character of the ware appears only when a slide is prepared and examined under a petrographic microscope, when the porcelanous character becomes so strongly evident that mistake is impossible. The frothiness of the body which masks its porcelanous features from macroscopic observation is also plainly visible in the slide.

We are not at all interested in the philological interpretations of the Chinese term *ts'e*. Our identification of this new pottery with the early *ts'e* of Chinese records rests solely on archæological arguments, not on any philological considerations.

B. LAUFER.
H. W. NICHOLS.

Field Museum, Chicago, November 8.

I AGREE with most of what I have read in Messrs. Laufer and Nichols's work which made any impression on my mind, and I also agree likewise with what is said in the above letter. I except the impression conveyed by the title, and in some parts of the text of the excellent brochure, as well as in the present letter, namely, that the Han pottery (body and glaze) referred to can be called porcelanous or the froth of porcelain. As they say, it is stoneware—and is not a particularly good variety at that. If Messrs. Laufer and Nichols will apply the petrological test to a good class of "acid brick," such as is used in the Glover's tower of a sulphuric acid works, they will find just as much, or even more, ground for stating that these bricks are porcelainic. I have compared the two bodies and would vote in favour of the bricks. Similar remarks would also apply to ancient and modern ware made from the so-called vitreous clays when fired, for they, too, have a similar character, and many have a similar chemical composition. Ware like the so-called Böttcher, or Böttger, "porcelain" should not be called porcelainic—excepting, perhaps, as a "registered trade mark" or in metaphor. Nor is it any real contribution to history to call it the precursor of porcelain in Europe when we recall that numerous analogous cases must have been in the alchemist's hands centuries before Böttger's time. The analogy is surely valid also in China.

In my comments I tried to convey the impression that Messrs. Laufer and Nichols's suggestion was not in accord with the technical concept of porcelain in our country, but I can quite understand that they may be working with another concept of porcelain which enables them to apply the term as an adjective to the pottery in question. It would be better if these points were threshed out before a technical society, since this is scarcely the place to make an attempt to develop a standard definition of porcelain uniformly acceptable. The main discussion would, I take it, work round the body—the glaze *per se* would give less trouble.

Nearly all beginnings are obscure, and Messrs. Laufer and Nichols have made a meritorious contribution to the subject which in the past few months I have strongly recommended to many students.

J. W. MELLOR.

Stoke-on-Trent, December 6.

MAGNETIC AND ELECTRICAL OBSERVATIONS AT SEA.[1]

THE handsome volume before us is principally concerned with the magnetic and electrical observations made at sea by the *Galilee* (1905–8) and the *Carnegie* (1909–16). It also includes some observations made on shore in connection with the cruises of the two vessels. Some of the contents appeal only to a narrow circle, but much is of general interest. Thus we have the "charter party" by which Mr. Matthew Turner, managing owner of the brigantine *Galilee*, of the net tonnage of 328, contracted to maintain the vessel tight, staunch, sound, strong, and seaworthy with a sailing master, two mates, six seamen, and two cooks. Then we have the instructions issued by the director of the Department of Terrestrial Magnetism to the master before each cruise, the report of the master, the daily log, and particulars of all the instruments on board. The parts of most general interest are the descriptions of the observational instruments copiously illustrated in the plates, the reduction formulæ, the tables of observational results, including the graphical illustration on pp. 424–29 of the errors in current magnetic charts, and the discussion of the electrical observations. A certain amount of the material has already appeared in a less complete form in earlier publications, but the present volume collects everything together and shows the gradual development of ideas.

The portions of the volume relating to the *Galilee* and the *Carnegie* magnetic observations are indexed separately, and there is a third index for the electrical observations, so that the volume is practically in three parts. The *Galilee* seems to have been an excellent sailing vessel, and as suitable a one for magnetic observations as could have been hired in 1905. But, like any ordinary vessel, she had a magnetic field of her own, the elimination of which required frequent "swingings" of the ship and all the elaborate procedure which renders magnetic work at sea so burdensome. With the experience they gradually acquired, Dr. Bauer and his coadjutors gradually saw their way to the construction of a ship practically free from iron. Plans were prepared in 1908 by Mr. Gielow, of New York. The keel was laid in February, 1909. In June, 1909, the *Carnegie* was duly launched and christened, and on August 21 of the same year she entered on her trial cruise. With equipment she cost about 115,000 dollars. She is primarily a sailing vessel, but with auxiliary propulsion. The motive power is derived from an internal-combustion engine of 150 horse-power, working with gas produced from anthracite coal. The engine itself is essentially bronze, but steel of a total weight under 600 lb. had to be used for certain parts. The *Carnegie* has been "swung" on various occasions, but, to all intents and pur-

[1] Researches of the Department of Terrestrial Magnetism. Vol. iii., "Ocean Magnetic Observations, 1905–16, and Reports on Special Researches." By L. A. Bauer, Director, with the collaboration of W. J. Peters, J. A. Fleming, J. P. Ault, and W. F. G. Swann. Pp. v+447, with 25 plates and 35 figures in the text. (Washington, D.C.: The Carnegie Institution of Washington, 1917.)

poses, when proper care is exercised in stowing the cargo, she is non-magnetic. This enables observations to be taken in less time and with higher accuracy than on the *Galilee*. Between them the *Galilee* and the *Carnegie* have traversed 224,000 miles of ocean, and declination observations have been taken once for each 109 miles on the average, but, owing to the improved facilities, the average distance apart of the *Carnegie's* stations has been less than half that of the *Galilee's*.

The experience of sea conditions has led to modifications of the instruments available in 1905 and to the development of new ones. Much work has been done with the Lloyd-Creak dip-circle, or, as the present volume calls it, the "sea dip-circle." This was devised by Capt. Creak as an improvement of the Fox circle. When provided with deflection needles and weights, after the method devised for land circles by Humphry Lloyd, it supplies the total force as well as the dip (I), and so indirectly the horizontal force (H). By adding a compass needle and a simple contrivance which enables the distance of the deflecting needle to be varied, the Carnegie Institution has made the instrument also give the declination (D), rendering it at the same time more serviceable for its original purpose. While the dip-circle can supply values for D and H, these are not quite so accurate as those given by special D and H instruments. The primary declination instrument as used on the *Carnegie* is a somewhat elaborate modification of the Ritchie liquid compass. For measuring H a new instrument termed a "sea-deflector" has been invented. It employs a deflection method analogous to that adopted with the ordinary land magnetometer. The deflected needle is the magnet system of a liquid compass; the deflecting magnet is horizontal, but with its centre in the same vertical as the centre of the deflected needle. It is attached to a sighting arrangement. When the compass needle is sighted it is known that it and the deflecting magnet are at right angles to one another. If when this occurs u is the inclination of the compass needle to the magnetic meridian,

$$H = mC/\sin u,$$

where C may be regarded as a constant, and m is the magnetic moment of the deflecting magnet. Allowance may be made for the variation of m with temperature; and comparisons made, when opportunity offers, with ordinary magnetometers on land supply the necessary information as to the decay of m with time. Another new departure, known as the "marine earth-inductor," is a form of dip-inductor suitable for use at sea. It has a moving-coil galvanometer, the sensibility of which with a scale distance of 1 metre is 1 mm. $= 10^{-8}$ ampere, the period being 2·4 seconds. An absolutely null method is not feasible, but this does not prove a serious drawback when care is taken to secure a nearly uniform speed of rotation of the coil. Under favourable conditions the inductor appears an instrument of higher precision than the dip-circle, but it requires at least two, and preferably four, observers. A guiding principle seems to have been to have at least two independent ways of measuring D, I, and H, and to use the less exact instrument as a check on the more exact.

FIG. 1.—The non-magnetic ship, the *Carnegie*.

The magnetic sea observations taken on each cruise are numbered and tabulated separately. Each table gives the date, the geographical coordinates, and the values of D, H, and I. Except in the case of the two last cruises of the *Carnegie*, the results for which appear only to be preliminary, the tables also include particulars of the hours of observation, the instruments used, the ship's course, the angle of roll, the state of the sea and the weather. Observations were often taken with

the ship rolling through 30°, and even at times 40° or more.

The magnetic observations made on shore are discussed in separate tables, and there are exact descriptions of the stations occupied. Considerable local disturbance was encountered in Madeira, the Bermudas, St. Helena, Mauritius, and especially in Iceland near Reykjavik. In such cases several adjacent sites were occupied.

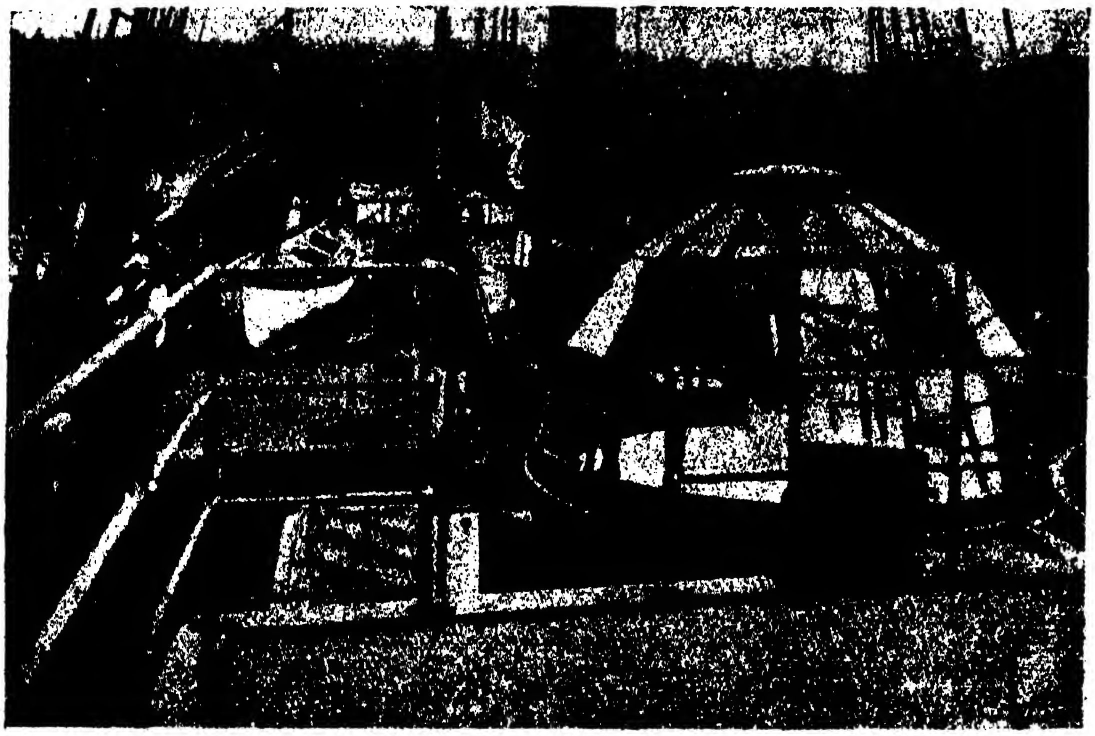

FIG. 2.—After observing-dome on the *Carnegie* with sea-deflector inside.

The part dealing with atmospheric electricity possesses many features of interest. Several new instruments are described, one for measuring potential gradient at sea. This was standardised by means of simultaneous observations on shore when the *Carnegie* was in harbour. The electrical elements observed included the potential gradient, the conductivities arising from positive and negative ions, the number and mobility of positive and negative ions, the air-earth current, the number of pairs of ions produced per c.c. per second in a closed copper vessel, and the radio-active contents of the air and of sea-water. Regular meteorological observations are also included. The results obtained are numerous and are given in tables on pp. 403–5. The discussion of the results is accompanied by much information as to the corresponding data obtained by previous observers on land and sea, and is practically equivalent to a text-book on atmospheric electricity.

The conclusions drawn are summarised on p. 422, the following being perhaps the most interesting. The potential gradient seems to be much the same over the different oceans, the mean daily value being about 113 volts per metre. There is a distinct diurnal variation, of the same general type as that for the year as a whole at Kew, *i.e.* having two maxima and two minima, but the principal maximum occurs near midnight, *i.e.* two or three hours later than at Kew. The average numbers of *plus* and *minus* ions per c.c. were respectively 804 and 677, numbers very similar to those encountered on land. The mean value found for the mobility was 1·30 cm./sec. for both *plus* and *minus* ions. The mean value found for the air-earth current was $9{\cdot}5 \times 10^{-7}$ E.S.U. The number of pairs of ions produced per c.c. per second in a closed copper vessel shows little variation over the ocean whether with locality, season of the year, or hour of the day. The mean found was 3·8. The average radium emanation contents in curies per cubic metre of air found over the Pacific and sub-Antarctic oceans were respectively $3{\cdot}3 \times 10^{-12}$ and $0{\cdot}4 \times 10^{-12}$, the larger of these values being only some 4 per cent. of the average value over land.

We learn that two more volumes, iv. and v. of the series, are to deal with later observational results, secular change, and the reduction of all the results, both for land and sea, to a common epoch. It is hoped that complete world charts based on these observations may be constructed during 1918.

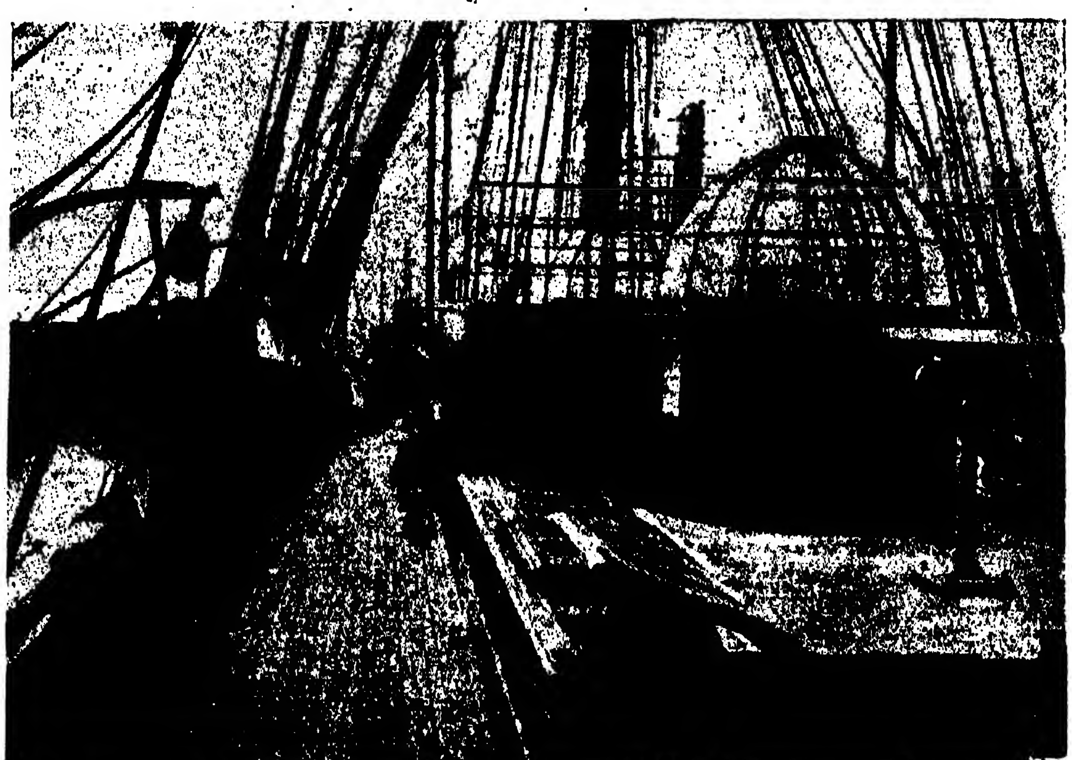

FIG. 3.—View of the bridge on the *Carnegie* and observing-domes.

C. CHREE.

AGRICULTURAL EDUCATION AND RESEARCH IN THE UNITED STATES.

IN the latest bulletin of the Carnegie Foundation for the Advancement of Teaching[1] an elaborate account is presented of the course of legislation in America which led to the foundation and endowment of the agricultural colleges and experiment stations. The former are known as the "land-grant" colleges, and this publication explains how this name arose. The foundation of these colleges, of which each of the States in America possesses at least one, dates from 1862, when the Morrill Act of that year appropriated the proceeds of six and one-third million acres of public lands for the purpose of founding in each State of the Union a College of "Agriculture and the Mechanic Arts." For many years after their foundation the land-grant colleges did not confine themselves to agriculture, and up to the close of the nineteenth century the number of students who graduated in agriculture was comparatively small.

In 1890 further endowments were voted by Congress, which by annual increments finally reached 5000*l.* per annum for each State in the Union. Again, in 1907, the annual subvention to each State was raised to 10,000*l.* per annum. In the meantime a step of great consequence was taken, one which has done much to stimulate agricultural education and research in the United States. This was the establishment of experiment stations in connection with the land-grant colleges as a result of the famous Hatch Act of 1887, which appropriated 3000*l.* per annum for each of these stations. By 1906, when an Act was passed raising the appropriation for each station to 6000*l.*, forty-eight of these stations had been established. Again, in 1914, further appropriations were voted for college "extension" work, beginning with 2000*l.* for each State, to be followed by annual increments of indefinite amount until the aggregate appropriations for this purpose in the whole country should reach a sum of 800,000*l.* But still Congress was not satisfied. By an Act passed this year further appropriations were sanctioned for the furtherance of agricultural education, which by 1926 will amount to 600,000*l.* per annum. Excluding the appropriations in aid of extension work, the aggregate Federal grants in aid of higher agricultural education and research are now 1,175,000*l.* per annum. The individual States of the Union have also increased their aid *pari passu*, so that in 1915 the total income of the colleges and experiment stations had reached the astonishing figure of 7,200,000*l.* The expenditure on higher agricultural education and research in England and Wales has a sorry appearance if contrasted with these remarkable figures. The normal State expenditure per annum in England and Wales is about 20,000*l.* for higher education and 35,000*l.* for research, not much more than what one State in America receives for similar purposes.

The author of the bulletin under notice expresses some alarm at the rapidity of recent developments. He appears to think that there is still too much fluidity of opinion in regard to the scope and methods of vocational education, and that the money available will be squandered on unfruitful educational experiments. However that may be, it is surely a healthy sign that public opinion, as reflected by the Legislature, recognises the need for better scientific and technical training.

It is somewhat remarkable to find that attention has been given to military training in the land-grant colleges ever since their foundation. Special officers are detailed to take charge of the instruction in military subjects.

A remarkable feature of the development of agricultural education in America is the sudden leap upwards which the number of students of agriculture has taken since 1906. In that year the total number of students was nearly 3000; in 1914 the figure was nearly 15,000. The bulletin fails to give any satisfactory reason for the suddenness with which the change set in. We venture to suggest that the demand for higher education in agriculture may have been stimulated by the extensive programme of demonstration fields upon which many of the States have recently embarked. These demonstration fields are designed to provide object-lessons of improved practice, and the extent to which they have been scattered over the country far surpasses anything that has ever been attempted here.

What is the lesson for this country from this record of American experience and progress? Surely, that we, too, should have faith and the courage to spend, especially on research. To begin with, some of the expenditure might be unfruitful, but one of the main obstacles to progress in the past has been the failure of agricultural research to attract the best scientific talent, a failure in large part due to the fact that the study of the sciences bearing on agriculture offered no career. Even as matters stand, the salaries of the teaching and research posts are inadequate, and in view of the rising demand for scientific work in the industries generally, the inadequacy is becoming more acute.

[1] Bulletin No. 10, "Federal Aid for Vocational Education." By Dr. I. L. Kandel. (New York City: Carnegie Foundation for the Advancement of Teaching.)

DR. A. M. W. DOWNING, F.R.S.

DR. ARTHUR MATTHEW WELD DOWNING, whose death was announced in NATURE of December 13, was born in Ireland on April 13, 1850, being the youngest son of the late Mr. A. M. Downing. He graduated at Trinity College, Dublin, where he gained the gold medal of his year in mathematics. He went soon afterwards to the Royal Observatory, Greenwich, where he was an assistant for twenty years. He was elected a fellow of the Royal Astronomical Society in 1875, and of the Royal Society in 1896.

He was secretary of the former society from 1 to 1892, and afterwards vice-president. He contributed seventy-five papers to it between 1877 and 1910, which show the keen interest that he took in the improvement of the fundamental constants of astronomy. He revised Taylor's Madras Catalogue and made systematic comparisons of the Star Catalogues of Greenwich, the Cape, Washington, Cordoba, Melbourne, Hong-Kong, etc., with the object of deriving their systematic errors. He discussed the measures of the planetary diameters, and investigated the errors of the tabular orbits of Juno and Flora.

This work formed an admirable preparation for the post of superintendent of the Nautical Almanac Office, to which Dr. Downing was appointed in 1892 on the retirement of Dr. Hind. He retained this post for eighteen years, retiring early in 1910. During his tenure of office the solar and planetary tables of Newcomb and Hill replaced those of Le Verrier, the list of ephemeris stars was greatly enlarged, and Besselian coordinates were introduced into the eclipse and occultation sections, facilitating the accurate computation of these phenomena. The "Lunar Distance" tables were dropped, as practically obsolete in navigation, and their place was taken by the physical ephemerides of the sun, moon, and planets, the regular publication of which is a great convenience to observers. They were previously contributed to the Monthly Notices by Mr. Marth, and have led to an increase of our knowledge of the surface currents of Jupiter. Dr. Downing took part in the international conference of directors of ephemerides which met at Paris in 1896 to endeavour to attain uniformity in the adoption of astronomical constants: its efforts were partly successful, agreement being reached on the questions of precession, nutation, aberration, and solar parallax. He was one of the founders of the British Astronomical Association in 1890, and was its second president (1892–94). He took part in two of the eclipse expeditions organised by it—to Vadso, Lapland, in 1896, and to Plasencia, Spain, in 1900.

Dr. Downing availed himself of the publication of the Cape Photographic Durchmusterung in 1899 to investigate the distribution of stars south of the equator, for which complete homogeneous material had previously been lacking. He found that the galactic condensation of the faint stars was greater in the southern hemisphere than in the northern. In conjunction with Dr. Johnstone Stoney he calculated the perturbations of the Leonid meteors between 1866 and 1899. Their results were published too late to warn the public of the probable non-appearance of the shower in 1899, so that considerable disappointment was caused, though the result was really in accord with calculation.

Dr. Downing spent the last few years in quiet retirement, owing to failing health. His tragically sudden death on December 8 resulted from angina pectoris. He leaves a widow and daughter.

A. C. D. Crommelin.

NOTES.

The death of Mrs. Garrett Anderson on December 18, at eighty-one years of age, deprives the world of a pioneer whose persistent efforts opened to women the portals of institutions having the power to confer qualifications to undertake medical practice. She was the first woman to secure a medical diploma in this country, and she lived to see a steady stream of capable women enter the door which she was chiefly the means of opening. Mrs. Garrett Anderson was born in London in 1836, and in 1860 began her medical studies with the view of obtaining an English qualification as a practitioner. No medical school of the metropolis would receive her as a student, and the Royal College of Surgeons, as well as the Royal College of Physicians, declined to allow her to sit for their examinations. She obtained, however, private tuition in anatomy and surgery, and studied at the London Hospital as a nurse; and after completing her course, was able to establish her claim to be examined by the Society of Apothecaries, which was compelled by its charter to admit to examination all persons, irrespective of sex, who presented themselves after passing through an approved course of study. She thus obtained the desired qualification of licentiate of the society, and began to practise medicine. In 1866 she opened a dispensary near Lisson Grove, Marylebone, and out of this undertaking grew the New Hospital for Women in the Euston Road, of which she remained senior physician until 1890. With Miss Jex-Blake, Mrs. Garrett Anderson endeavoured to induce the University of Edinburgh to grant medical degrees to women, but unsuccessfully. She went to France, however, and obtained the degree of doctor of medicine of the University of Paris in 1870. The refusal of the northern University to admit women to its medical schools led to the establishment of the London School of Medicine for Women, and the alliance of this school with the Royal Free Hospital completed the provision for teaching required by the General Medical Council. From its foundation in 1876 until 1898 Mrs. Garrett Anderson lectured to the students on medicine, and from 1883 to 1903 acted as dean of the school. In 1896–97 she was president of the East Anglian branch of the British Medical Association, and gave an address on "The Progress of Medicine in the Victorian Era." At Aldeburgh, Suffolk, which was her home for many years, she was elected mayor in 1908, and was the first woman to occupy such a post in England. In August last the honour of Commander of the Order of the British Empire was bestowed upon her by the King. Medical women will long cherish the memory of the pioneer to whose courage and strong character they largely owe the position now occupied by them.

The student of natural science is continually surprised by the inaccuracies which appear when writers and artists in the general Press touch even the most elementary conceptions of the natural world in which we live. Mr. J. Reid Moir has just directed our attention to a remarkable case in a large advertisement published in various newspapers on December 4. It purports to be a reply to a question propounded in displayed type, "How did Man conquer the Dinosaurus?" and is made attractive by a sketch of a Diplodocus-like animal being attacked by primeval man. The most elementary acquaintance with geology would have assured the author that his question could never arise, because all the dinosaurs were extinct long before man appeared; and even if, presuming on little knowledge, he had mentally confused a dinosaur with a mammoth, he still made a fundamental mistake (as Mr. Moir points out) in providing the huntsman with a Neolithic implement.

IT has been announced that a sum of money amounting to about 250,000*l*. has been bequeathed by the late Mr. G. F. Melville, advocate, Edinburgh, to be devoted to "the care and cure of cancer"; the benefits of the bequest do not, however, accrue until the death of certain beneficiaries under the will. The trust is to be administered by the Dean of the Faculty of Advocates, the Deputy-Keeper of the Signet, and the Master of the Merchant Company, and it is understood that the trustees have considerable discretionary powers in the choice of the methods by which the object of the testator may be best attained. No doubt the questions of provision, both for research work and for the care of patients, will be considered. In Edinburgh at present the treatment of cancer patients is carried on in the general hospitals, an arrangement which has the obvious advantage of not attaching a stigma to the sufferer from malignant disease, but as the hospital accommodation in the city has not increased with the population an addition to the available resources for treatment would be advantageous. On the research side, though isolated investigations, such as those of Russell on cancer bodies, have been carried out in Edinburgh, no organised attack has been made on the problems of cancer. In the summer of 1914, however, a scheme was being prepared for the erection, under the joint auspices of the University and of the Royal College of Physicians and the Royal College of Surgeons, of an extensive research institute in medicine as a memorial of Lister's connection with the Edinburgh School. This project the war has interfered with, but the promoters are definitely committed to carry it through whenever circumstances permit. It was part of the original plan that special provision should be made for research on cancer, so that the authorities of the Medical School have been quite alive to the necessity for initiating work on the subject.

DR. G. P. GIRDWOOD, emeritus professor of chemistry, McGill University, Montreal, died on October 2, in his eighty-fifth year. We are indebted to the *British Medical Journal* for the following particulars of his career. Dr. Girdwood was the son of Dr. G. F. Girdwood, and was born in London on October 22, 1832; he was educated at a private school, and later at University College and St. George's Hospital. He settled in practice in Montreal in 1864, and in the following year took the degrees of M.D., C.M. at McGill University. In 1869 Dr. Girdwood was appointed lecturer in practical chemistry in the faculty of medicine, McGill University; in 1872 he became professor of practical chemistry, and two years later professor of chemistry. When he retired from this chair in 1902 he was named emeritus professor of chemistry. He occupied a number of other important positions, among them the presidency of the Röntgen Society of America and the vice-presidency of the Canadian Branch of the Society of Chemical Industry. He was also one of the original fellows of the Royal Society of Canada. "Dr. Girdwood will be remembered as a conspicuous figure among the scientific men of Canada during the last quarter of the nineteenth century—an example of the all-round man of science that will become rarer in this age of specialisation; for, though fundamentally a chemist, he had a sound knowledge of medicine, surgery, medical jurisprudence, botany, physics, and microscopical technique, including photomicrography. The Rodgers and Girdwood method of detecting strychnine was devised by Dr. Girdwood and Dr. Rodgers, of London, and it was Dr. Girdwood also who first applied reagents for the detection of forgeries, counterfeits, and the identification of handwriting. He was one of the first to apply the stereoscopic principles to X-ray prints."

WE regret to learn from the *Memorias do Instituto Oswaldo Cruz* (vol. viii., fasc. ii.) of the death of the distinguished director of the institute, Dr. Oswaldo Gonçalves Cruz. After completing his course as a student of medicine in Brazil, Dr. Cruz worked for some time in the Pasteur Institute in Paris. Soon after his return to Brazil the Government decided to take measures for the improvement of the health of Rio de Janeiro, especially in regard to yellow fever, and in 1903 Dr. Cruz was appointed head of the public health department, with full powers to take all necessary measures. He prosecuted the campaign against yellow fever with scientific method and with the utmost vigour, instituting for this purpose "mosquito brigades" and allied services, comprising about 2000 men. The breeding places of *Stegomyia calopus*, the carrier of yellow fever, were abolished or screened, all infected persons were isolated, and in about three years yellow fever was stamped out in Rio. Dr. Cruz also devoted careful attention to measures for the suppression of smallpox and the plague with such success that by 1909 smallpox had almost disappeared in Rio, and there has been no case of plague for five or six years. In 1901 Dr. Cruz was appointed director of an institute for work on serum therapy; he soon enlarged the scope of the work so as to include other branches of experimental medicine, together with pathology and parasitology, and about ten years ago the present institute was built and named in his honour. He was a man of great activity and stimulating personality, and brought together a band of workers who have made his institute famous as a centre of researches of a high order. Dr. Cruz will be held in honoured remembrance for his powerful support of all phases of medical research in Brazil, and for his inestimable services in the cause of public health in Rio.

AT the annual meeting of the Yorkshire Geological Society held at Leeds on December 12, Mr. T. Sheppard read a paper on "Martin Simpson and his Work." Simpson was born in 1800 and died in 1892. He spent most of his life in the Whitby district, and for more than half a century had charge of the valuable geological collections in the Whitby Museum, though for a short period he was the curator of the Yorkshire Geological Society's collection. He was one of the first workers among the Liassic rocks of Yorkshire, and considering the early date of his researches, the enormous amount of information he accumulated is remarkable, and his methods of research had a surprisingly modern air. He was the author of a number of geological memoirs, most of which are now exceedingly scarce. Mr. Sheppard exhibited a complete series of these works, which he had collected, the most important being a memoir on the "Ammonites of the Yorkshire Lias," which was published in 1843, and long ago was said to be so rare that only one copy existed. Another work, published when Simpson was eighty-four years of age, is "The Fossils of the Yorkshire Lias," in which no fewer than 743 species were enumerated and described. Simpson measured with a foot-rule the thickness of the beds in the cliffs north and south of Whitby, taking special note of the specimens peculiar to each bed—a very early example of zonal collecting.

THE next meeting of the Faraday Society will be held on January 14 in the rooms of the Royal Society of Arts at 5.30 p.m., when a general discussion on the setting of cements and plasters will be opened by Dr. C. H. Desch.

WE regret to note that *Engineering* for December 14 records the death on December 9 of Mr. Wm. M. Urie. Mr. Urie was born in 1850, and after a varied engineering career at home and on the Continent, became

works manager of the Caledonian Railway Company's Works at St. Rollox, Glasgow. He was elected a member of the Institution of Mechanical Engineers in 1899.

WE learn from the *Chemical Trade Journal* that Mr. W. J. E. Foakes, late Chief Government Inspector of Explosives for Cape Colony, has died in London. For eleven years Mr. Foakes was chief assistant and partner with the late Dr. Dupré, chemical adviser to the Home Office. He was appointed Chief Government Inspector of Explosives for Cape Colony on the recommendation of Sir Vivian Majendie in 1898.

THE council of the Institution of Electrical Engineers has passed the following resolution, which has been transmitted to Sir Albert Stanley :—"That the council of the Institution of Electrical Engineers welcomes the Non-ferrous Metals Bill, approves its principles, and congratulates the President of the Board of Trade on its introduction. The council, representing an institution the members of which are interested so widely in the supply of non-ferrous metals, unanimously supports this measure designed to keep the control of the supply of these essential metals in British hands."

THE thirty-fifth annual meeting of the American Ornithologists' Union was held in Cambridge, Mass., on November 12–16. The following officers were elected for the ensuing year :—*President*, J. H. Sage; *Vice-Presidents*, H. W. Henshaw and Dr. Witmer Stone; *Secretary*, Dr. T. S. Palmer; and *Treasurer*, Dr. J. Dwight. Two additions were made to the list of honorary fellows, Dr. A. H. Evans and Mr. W. L. Sclater, and Dr. F. E. Beddard was elected a corresponding fellow. The next meeting, in 1918, will be held in New York City.

MANY who are acquainted with the works of Mr. Ewing Matheson will regret to hear of his death, which is announced in *Engineering* for December 14. Mr. Matheson was in his seventy-eighth year, and had been a member of the Institution of Civil Engineers since May, 1876. His books deal with civil engineering subjects, and he was a partner in the firm of Messrs. Andrew Handyside and Co., Derby, in which connection he was actively associated in all the large civil engineering undertakings successfully carried out by his firm. He took an active part in the business and municipal life of Leeds.

IT is reported in *Science* that a special board of chemists has been appointed in the United States to investigate explosives and the uses of gases in warfare and to act as advisers to the Bureau of Mines. The board will study the problem of increasing the production of materials used in the manufacture of explosives and will advise the bureau in the operation of the recently enacted law regulating the sale of explosives. The members are :—Dr. W. H. Nichols, of the General Chemical Company, New York (chairman); Prof. H. P. Talbot, head of the chemical department of the Massachusetts Institute of Technology; Mr. W. Hoskins, of Chicago, a consulting chemist; Prof. H. P. Venable, of the University of North Carolina; Prof. E. C. Franklin, of Stanford University; and Dr. C. L. Parsons, of the U.S. Bureau of Mines.

THE natural history and possibilities of the Murray River are graphically described in the *Victorian Naturalist* for August by Mr. O. W. Rosenhain. A system of irrigation canals and locks, he points out, would convert many thousands of miles, now barren waste, into fertile land. He deplores the destructiveness of the early settlers, who have destroyed millions of pounds' worth of trees, the bleached trunks of which now extend along the banks on either side as far as the eye can reach. A scheme of irrigation has actually been proposed by which immense areas all along the Murray, from Echuca to Lake Alexandria, will be converted into fertile land capable of supporting more than the whole present population of Australia. At a rough estimate, it is contended, more than 3,000,000 acres could be transformed into corn and grass land and flourishing orchards. It is to be hoped, therefore, that this work of reclamation will not be long delayed.

IN January, 1914, two young king penguins, still in the nestling-down stage, were presented to the Scottish Zoological Society. A very careful study of their moulting has been made by Prof. J. Cossar Ewart and Miss Dorothy Mackenzie, and they have placed the results of their observations on record in the Transactions of the Royal Society of Edinburgh, vol. lii., part i. (1917). So good an opportunity of studying this stage of the moulting of this species has never fallen to the lot of any previous workers, and the authors have made good use of their chance. Perhaps the most interesting item in this communication is that concerning the arrested moult, which showed signs of beginning in May, when it was four months overdue, and was not resumed until August. It then followed its normal course, but the resultant plumage was scarcely different from that of the adult—that is to say, the immature dress was skipped. A precisely similar omission was induced by changing the conditions of the environment in the case of bobolinks by Mr. W. Beebe in the New York Zoological Gardens about ten years ago. But here the change was from nuptial to nuptial plumage, instead of from the nuptial to the eclipse, or "winter," plumage. The authors, by the way, scarcely seem to have grasped the nature of these plumages, to judge from their comments thereon. Nor is their comparison between the kingfisher and the king penguin likely to be regarded by ornithologists as more happy. We cannot answer for the Neo-Lamarckians, but we find it difficult to believe that such a one "might even assert that, notwithstanding the necessity to moult, birds have long been endeavouring not only to obtain as brilliant a plumage as possible, but to wear fine feathers all the year round."

WART disease of potatoes (*Chrysophlyctis endiobioticum*) has long been known in this country, but in recent years it has become much more prevalent, owing partly to the popularity of certain varieties of potatoes which are now known to be highly susceptible to the disease. Fortunately for the potato-growing industry in many parts of the country, it has been found that certain varieties of potatoes are absolutely immune. With the view of ascertaining the character of each variety in this respect, the Board of Agriculture has carried out in each of the last three years extensive field trials of varieties at Ormskirk, which is the centre of an important potato-growing district that has suffered serious losses through the ravages of the disease in recent years. A report on the three years' trials has now been published in the November issue of the *Journal of the Board of Agriculture*, and is issued separately as Food Production Leaflet No. 21. The report gives a detailed account of the trials, the results of which are of the greatest practical value. Brief notes on the chief immune varieties are appended.

THE fourteenth annual report of the West of Scotland Agricultural College comprises a series of reports on experimental work and other matters which have engaged the attention of the staff. These reports have

been issued as separate bulletins during the past year, and some have already received notice here. Special interest attaches to the report by Prof. R. A. Berry on the results of experiments with cows and dairy produce, of which it is only possible to mention the studies of the variation in the character of milk throughout the lactation period, and the separate study of the changes in the composition of Cheddar cheese during ripening. A further report by Prof. Berry on "The Utilisation and Eradication of Bracken" adds very materially to previous knowledge on this important subject. Special attention must also be directed to the exhaustive report on medicinal plants by Mr. A. Hosking, to which is appended a very comprehensive list of hardy herbs, trees, and shrubs used in medicine. The concluding report by Principal Paterson on experiments in the manuring of oats is very illuminating as to the possibility of raising the average yield of oats in Scotland by the judicious use of manures. The average yield on the fully manured plots in these experiments was about 30 per cent. above that obtained on the unmanured plots, and fully 33 per cent. in advance of the average yield for Scotland.

THE first number has reached us of the *Journal of Dairy Science*. This publication, which is of American origin (Baltimore: Williams and Wilkins Co.; London: Cambridge University Press), is intended to serve as the official organ of the American Dairy Science Association, and to be the medium for scientific discussion of the problems connected with dairying. The value of such a journal, if conducted on the right lines, must be very great, for in it the higher chemical and bacterial questions can be dealt with in a manner which is scarcely possible in the publications which are at present available. The first article in the journal is the text of the address delivered at the opening of the new dairy buildings of the University of Nebraska. The subject-matter of the address is well chosen, and the striking facts brought forward by Prof. R. A. Pearson are worthy of close consideration, particularly at the present time. Messrs. R. S. Breed and W. A. Stocking write on the results of a large number of bacterial analyses of milk. Special attention is directed to the errors which arise in making the counts, and the varying results obtained by the direct and plate methods in the hands of different workers. A very full report is made by the Committee on Statistics of Milk and Cream Regulations regarding the ordinances which obtain in the cities and towns of the United States. This report is of special interest as showing on what lines those responsible for the local administration of dairy laws and regulations are working. It is to be hoped that English dairy investigators will support and contribute to this publication, for the questions they have to elucidate are largely those which concern all nations.

THE Department of Statistics of Calcutta has published vol. ii. of the agricultural statistics of India for 1914–15, which deals with the area under crops, live stock, land revenue assessment, and transfers of land in the Native States. Unfortunately, this volume is much less complete than vol. i., which dealt with British India. The total area of the Native States is given as 777,000 square miles, but agricultural statistics are available only for one-sixth of that area. Detailed statistics are given, however, of the States which furnish returns.

WE have received from the Brooklyn Institute of Arts and Science a copy of a short illustrated guide to the geographical models in the Children's Museum in Bedford Park, Brooklyn, New York. The models, which seem to number eleven, are attempts to present scenes from different lands, so chosen as to illustrate simply and in a striking way the relation of man to his surroundings. The scenes represented are in Greenland, Lapland, Antarctica, the South Seas, Central Australia, the Brazilian forests, the Sahara, East Africa, Patagonia, and the hills of Afghanistan. So far as can be judged by the photographs of the models, they are well executed, but much of their value must necessarily depend on colouring and perspective. No indication of the scale is given, but we gather that the models are life-size.

UNDER the title of "The Use of Mean Sea-level as the Datum for Elevations," Mr. E. L. Jones, of the U.S. Coast and Geodetic Survey, has collected the opinions of a number of engineers and others throughout the United States on the datum to which elevations should be referred. All agreed that mean sea-level should be chosen, and that it should be adopted without further delay. Great confusion arises in some places owing to the number of datum lines used. Thus, in Salt Lake City the corporation, the weather bureau, and the two railway companies all use different levels of reference. To facilitate the adoption of mean sea-level as the standard, Mr. Jones points out that it is essential that precise levelling should be extended over the whole of the United States. At present it is entirely inadequate, being only 1·2 miles per 100 square miles of territory. The extension of the net, as quickly as possible, would allow arbitrary data to be discarded, and would result in increased usefulness in American maps. The paper is published as No. 60 of the United States Coast and Geodetic Survey Series.

As a seismic region, the Middle Mississippi valley will always be of interest owing to the series of great earthquakes which occurred at New Madrid in the years 1811 and 1812. Since then, few years have passed without one or more slight shocks in the district, one of the strongest being that which occurred on April 9 last. This earthquake, which is briefly described by Mr. R. H. Finch in the current Bulletin of the Seismological Society of America (vol. vii., pp. 91–96), is chiefly remarkable for its extensive disturbed area. Though the damage caused by the shock was slight, the earthquake was felt over a district covering about 200,000 square miles. The author infers in consequence that the origin was deeply seated. In the same bulletin Dr. Otto Klotz makes several suggestions for the study of earthquakes in the United States. He insists on the importance of prompt publication of monthly bulletins by the numerous observatories in the country, and recommends the foundation of a central bureau in Washington. Mr. Hamlin's short paper (pp. 113–18) shows how frequently earthquakes are now occurring in southern and eastern California.

ATTENTION may be directed to a very fine geological and topographical atlas of the Gympie Goldfields by the Chief Government Geologist, recently issued by the Queensland Geological Survey. This atlas comprises thirty-six sheets, drawn to the somewhat inconvenient scale of 1/4752, or six chains to the inch, beautifully executed, and apparently worked out in elaborate detail with the utmost care. The district is one of the more important of the goldfields of Queensland, which at one time produced a good deal of alluvial gold, though more recently its output has been chiefly reef-gold, derived from veins of quartz connected genetically, it would seem, with a group of altered diabasic rocks, tuffs, etc. The geological relations of these rocks to the adjoining slates, etc., are well brought out by this series of maps.

THE Geological Survey of Egypt has just issued the third part of its catalogue of invertebrate fossils in the Cairo Museum, by M. R. Fourtau. It comprises the Cretaceous bivalved shells, and is illustrated by seven beautiful plates. As in the previous parts, M. Fourtau uses specific names in a rather wide sense, being convinced that by this means it is easier to appreciate the relationships of a fauna than by multiplying names to denote minute differences. He is also inclined to use familiar and generally adopted names, instead of adhering strictly to the law of priority. His final table, illustrating the geological and geographical distribution of the fossils, includes 170 forms, of which not more than forty-two are peculiar to the Egyptian deposits. Four fresh-water shells are, curiously, found among them. The variable shells of the oysters are especially interesting, and good drawings of these occupy most of the plates. There are parallel variations in the different species depending on the several identical conditions under which they lived. Both the Survey and the author are to be congratulated on the mass of new facts they have brought together, and on the admirable manner in which these are published.

VOL. XXXIII. of the *Compte rendu* of the Société de Physique et d'Histoire Naturelle of Geneva contains a paper by Dr. A. Schidlof on a source of error which may be present in the determination of the electronic charge by Millikan's method. When fine drops of mercury are produced by blowing a gas through the liquid, they are found immediately after production to have a density identical with that of the liquid, but after a time their apparent density decreases considerably owing to the formation of a layer of oxide or of condensed gas on the surface. Dr. Schidlof points out that the same change may occur in the oil drops used by Millikan, and considers that the numbers given by Millikan show a progressive diminution of the electronic charge as the experiments continue, which could be explained by the formation on the oil drops of mean radius $5 \cdot 10^{-4}$ cm. of a layer of thickness 10^{-6} cm., of density 0·3. He considers that the true value of the electronic charge lies between $4.775 \times 10^{-}$ —the value given by Millikan—and 4.8×10^{-10}.

THE Manchester Steam Users' Association has just published its chief engineer's memorandum for 1916–17. Among other subjects discussed by Mr. C. E. Stromeyer is the action of caustic liquors on steel plates. Some rings were cut out of a solid plate, and were bored with a tapering hole; others had a tapering outside, and were forced into the first set of rings so that the external rings were under tension and the internal rings under compression. After treatment in a caustic-soda evaporator, the rings were cut up into small segments, and of each ring one short piece was bent inwards and the other outwards. The results were very consistent. All those which were in a compressed condition when exposed to the caustic bent double without the least sign of cracking; those under tension, when exposed to the caustic, cracked in innumerable places when bent. These cracks appeared both on the outer surface, which was in direct contact with the caustic, and on the inner surface, which was not in contact with the caustic, but was pressing hard against the compressed inner ring. Evidently, therefore, the influence of the caustic had penetrated through ¼ in. of metal. Mr. Stromeyer suggests that the action of caustic soda may have been the cause of the cracking of boiler plates in certain instances, and has also several suggestive remarks regarding the design of autoclaves used for the production of certain coal-tar dyes by treatment with strong caustic solutions. A number of autoclaves have been made from drawings found in Continental text-books, and these designs are nearly all faulty.

OUR ASTRONOMICAL COLUMN.

THE APPROACHING SHOWER OF JANUARY METEORS (QUADRANTIDS).—This shower will probably reappear on the nights following January 2 and 3. The best time to observe it will probably be on the early evening of January 3. Mr. T. W. Backhouse, of Sunderland, who has devoted much attention to this meteoric system during a long period of years, concludes that the maximum will occur on the morning of January 3. At that time, however, the gibbous moon will be shining and high in the sky. On the evening of the date mentioned our satellite will not rise until between 10 and 11 p.m., and in the dark sky between about 5.30 and 7 p.m. meteors should be abundant. The radiant point at $232° + 52°$ (8° S. of ι Draconis) will be due north at about 8.40 p.m., at an altitude of only 14° seen from the latitude of Greenwich.

The Quadrantid shower is sometimes very rich, though its principal activity is of very brief duration, and it is seldom well observed owing to the generally clouded English skies at this particular period of the year.

OBSERVATIONS OF β LYRÆ.—A valuable series of observations of the well-known variable star, β Lyræ, has been made at Catania by A. Bemporad (*Mem. Soc. Spett. Ital.*, September–October, 1917). The principal mean results of the observations during 1911–12 are as follows:—

	Mag.	Julian day	Interval in days
First principal minimum ...	4·39	2419,227·51	
First maximum	3·54	230·575	3·065
Second minimum	3·87	233·65	3·075
Second maximum	3·54	237·35	3·700
Second principal minimum...	4·39	240·43	3·080

The total range of variation was thus 0·85 mag., and there were indications that the second maximum was brighter than the first by about 0·02 mag. While the light-curve about the principal minimum was practically symmetrical, the descent to the secondary minimum was more rapid than the rise to the succeeding maximum.

RADIAL VELOCITIES OF STAR CLUSTERS.—At the Albany meeting of the American Astronomical Society Dr. Slipher announced some important results which he has obtained relating to the radial velocities of star clusters (Journ. R.A.S., Canada, vol. xi., p. 335). The instrumental equipment was that previously employed by him, with marked success, for spiral nebulæ. Ten clusters have been observed, and the velocities range from −410 to +225 km. per sec. The mean velocity, taken without regard to sign, is 150 km. per sec. As in the case of spiral nebulæ, the high velocities observed suggest the possibility that the clusters are distinct from our own sidereal universe.

PARALLAX OF THE RING NEBULA IN LYRA.—An attempt to determine the parallax of the central star of the Lyra nebula has been made by Mr. A. van Maanen, with the aid of photographs taken with the 60-in. reflector at Mt. Wilson (*Popular Astronomy*, vol. xxv., p. 630). Nine comparison stars were utilised, and the resulting relative parallax is given as $+0.002'' \pm 0.005''$. The absolute parallax would be $0.004''$, and as there is practically no doubt as to the association of the star and nebula, this indicates enormous dimensions for the nebula itself, namely, 330 and 250 times the diameter of the orbit of Neptune for the major and minor axes. Taking 14·1 as the visual magnitude of the central star, the above parallax leads to the low value of +7·1 for the absolute magnitude.

AERONAUTICS AND INVENTION.

THE names of the members of the Air Inventions Committee appointed by Lord Cowdray, the late President of the Air Board, were announced last week. They are as follows:—Mr. Horace Darwin, F.R.S. (chairman), Maj.-Gen. Luck, C.B., C.M.G. (vice-chairman), Sir Dugald Clerk, K.B.E., F.R.S., Sir Richard Glazebrook, F.R.S., Prof. H. L. Callendar, F.R.S., Prof. C. H. Lees, F.R.S., Prof. J. E. Petavel, F.R.S., Mr. L. Bairstow, C.B.E., F.R.S., Lt.-Com. Wimperis, R.N.V.R., Major G. Taylor, R.F.C., Capt. B. M. Jones, R.F.C., Capt. A. V. Hill, Munitions Inventions Department, Mr. J. P. Millington, and Mr. F. W. Lanchester. The main function of the Committee is to investigate inventions submitted to it. It will develop and put into operation as soon as possible any invention which promises to add to the efficiency of aircraft. Communications regarding inventions or ideas should be forwarded to the Air Inventions Committee, No. 2 Clement's Inn, W.C.2. There is no doubt that under such an expert Committee any new inventions that may be submitted will be adequately considered and speedily put to practical use if they are of value.

The *Geographical Review* for November, published by the American Geographical Society of New York, contains an excellent article on "Aeronautical Maps and Aerial Transportation," pointing out the great necessity which has arisen for aeronautical maps. Maps are of the utmost importance in naval and military operations, and the recent progress of aviation has made them equally important in aerial warfare. The practicability of long flights was amply demonstrated by the recent bombing expedition carried out by a Handley-Page machine, which flew from England to Constantinople in a series of eight flights, the total distance covered being nearly 2000 miles. To carry out such a flight with certainty the pilot must have good maps of the country over which he is to fly, and they should be special maps showing the country as seen from above, and indicating those landmarks which are most easily identified from a height. The *Geographical Review* gives a brief account of the various types of map in current use for aeronautical work, and prophesies that the work of making an aeronautical map of the world will have to be undertaken in the very near future. The accuracy of aerial photography is mentioned, and it is pointed out that such photography gives an excellent method of mapping a country—a method which is much more rapid than the older surveying processes, and is quite accurate enough for all practical purposes. The question of air routes and their regulation is dealt with at some length, and extensive quotations are given from Lord Montagu's recent lecture on this subject. The main point of interest of the article, however, is that dealing with the necessity of aeronautical maps, as there seems little doubt that the coming of peace will inaugurate a period in which flying will rank as one of the primary means of rapid conveyance, both national and international, and complete maps will then be absolutely indispensable.

Further details of the 2000-mile flight from London to Constantinople have now been made known as a result of a meeting held to celebrate this record flight. Mr. Handley-Page said that the machine used was a Handley-Page twin tractor biplane, fitted with two 275 h.p. Rolls-Royce engines. The weight of the machine "light" was 8000 lb., and fully loaded for flight 14,000 lb., so that the useful load carried—probably including fuel—was 6000 lb. The machine carried a crew of five: the pilot, second pilot, engineer, and two mechanics, together with their luggage and bedding. A very comprehensive set of spare parts was also carried to render the machine independent of local supplies in the event of a breakdown. Amongst other things, three spare radiators, three spare wheels, and two spare propellers were included. This flight to Constantinople is a world's record for a long-distance military flight, but there seems no reason why it should not be repeated, as no very great difficulties seem to have been experienced. The question of vulnerability to attack from the enemy's lighter machines will need careful attention if such flights are to become common. Heavy machines are generally under-powered as compared with light fighters, and have consequently much less climbing speed and flexibility of control. There will probably be a greater need for such machines after the war, and the present achievement leaves no doubt whatever that the employment of large machines for commercial purposes is already within the limits of possibility.

A very interesting article under the title "La Liaison aérienne et la Télégraphie sans Fil en Avion chez les Allemands" appears in *La Nature* for December 8. The importance of an effective liaison between the aeroplanes and their bases in connection with the regulation of artillery fire and the control of infantry attacks is discussed, and the early attempts to attain this end by visual signals is mentioned. Such signals necessitate that the aeroplane should fly practically over its base, and are therefore much limited in application. The method of dropping messages in special tubes suffers from the same disadvantage. For long-distance raids carrier-pigeons have been successfully employed. Wireless telegraphy has now solved the problem satisfactorily for reasonable distances. The reception of messages on the aeroplane has yet to be accomplished, the noise of the engine making the ordinary methods useless, and visual signals are still relied upon as a means of communication from the ground to the machine. The wireless apparatus in use on German machines is very compact and well designed. Current, both continuous and alternating, is supplied by a small generator, driven by an airscrew or "windmill," this method of driving being preferred to direct coupling to the engine, in spite of its lower efficiency, because it enables the set to be used while the machine is gliding with the engine off. The total weight of the wireless set is only 40 lb., and transmission is possible at two different intensities and three different wave-lengths. This provision is made in order that more than one aeroplane may operate in a given area. The range of the set is about twenty-five miles. It is impossible to give full details of the apparatus in this brief notice, but the original article in *La Nature* should be read by all who are interested in the application of wireless telegraphy to fire-control from aircraft.

THE PEOPLING OF MELANESIA.

IN a new work on the anthropogeography of the Pacific,[1] Mr. Churchill returns to the problems which he essayed to solve in his former works on "The Polynesian Wanderings" and "Easter Island" (*cf.* NATURE, August 10 and September 21, 1911, and August 14, 1913). In these he postulated a passage of the Polynesians through the Pacific in two streams, one passing to the north, the other to the south of New Guinea, and meeting in the Samoa-Tonga region, whence they dispersed to the far-eastern Pacific. The present work discusses the migration within and through the Melanesian region.

Sissano is a place on the north of New Guinea, a

[1] "Sissano: Movements of Migration within and through Melanesia." By William Churchill. Pp. 181+xvii charts. (Washington: The Carnegie Institution of Washington, 1916.)

little to the east of the Dutch-German boundary. It is regarded by the author as a place of exit for the northern migration from Indonesia, and he quotes in full an account of the people by Neuhauss. A vocabulary in the latter's work, "Neu-Guinea" (probably derived from the trader Schulz, described by Neuhauss as a "drunkard" and by Friederici as "a man of no particular intelligence"), is, when corrected by a shorter list of Friederici's, the basis of Mr. Churchill's argument.

Although the words discussed are so few (about 34), the author belittles the existing Melanesian vocabularies, and suggests (without authority) that others—Codrington, Ray, and Friederici—have based their conclusions on these scanty lists.

Mr. Churchill totally ignores the structure of the languages, and does not distinguish between Melanesian and non-Melanesian languages. His lists of cognate words are designed to show their variation from simple stems which the author finds in the Polynesian forms. Thus *makan*, "eat," is derived from *ani*; *tebu*, "sugar-cane," from *to*. Such derivations are impossible in Indonesian philology. The former presence of Polynesians throughout Indonesia is regarded as established by the tables. The author supposes them to have been expelled from the archipelago by a more cultured people from the mainland of Asia, who assumed some elements of the Polynesian speech.

Mr. Churchill's comparisons of Melanesian and Polynesian words are open to the same objection as those from Indonesia, for he will not admit that Polynesian is secondary to Melanesian. He traverses Friederici's suggestion of a Melanesian migration round the eastern end of New Guinea through Vitiaz Strait (*cf.* NATURE, December 5, 1913). The whole of the eastern part of the south coast of New Guinea is regarded by the author as belonging to Torres Straits, and the languages there are said to be more Polynesian towards the west. For the western part (*i.e.* the *real* Torres Straits region) he says there are no records, and hence he *supposes* that Polynesian survivals may be found there. This is to support the contention of a Polynesian migration through Torres Straits. But all the languages of New Guinea from the narrows of the Straits to the first Melanesian settlements at Cape Possession *are* known, and show no Polynesian survivals.

As to the island region of Melanesia, Mr. Churchill quotes from Dr. Rivers's "Melanesian Society" the chapter on kava and betel, but will not allow a possible origin of the kava culture in Melanesia.

Mr. Churchill's book is interesting, especially in its descriptive parts, and his views as to the directions of the migrations are clearly set forth in a series of charts. He does not disguise the difficulties of his thesis, but his desire to establish the pre-eminence of Polynesian among the languages of the Pacific has caused him to overlook many details which seriously militate against the soundness of his argument.

SIDNEY H. RAY.

CANADIAN EXPLORATION.

SOME information on the work of the Canadian Arctic Expedition additional to that already published appears in the *Geographical Review* for October (vol. iv., No. 4). The whole of the coast-line from Cape Bathurst to the eastern end of Coronation Gulf, except Cape Parry peninsula, was surveyed on a scale of ten miles to an inch. The surveys were extended to include Croker River and Rae River. Other surveys included much of the Mackenzie delta. The most important geological research of the southern party, with whose work this paper by Mr. R. M. Anderson deals, was the investigation of the copper-bearing rocks in the region of Bathurst Inlet. They occur on Banks Peninsula and most of the islands to the north of it. Though the ore so far discovered is of low grade, Dr. O'Neill, the geologist of the expedition, estimated the amount of ore at more than two billion tons, and believes that it can be profitably utilised. Water transport round Alaska would be long and uncertain, but a short railway to Great Bear Lake would probably solve the difficulty of export. The article is illustrated with two sketch maps and a number of valuable photographs.

The Geological Survey of Canada has published, as Memoir 84, a volume by Mr. C. Camsell on an exploration of the Tazin and Taltson Rivers in the North-West Territories. The exploration of this region between Lake Athabaska and the Great Slave Lake was undertaken by the author in 1914 by a canoe traverse from south to north. A compass survey was made and checked almost daily by sextant observations. The report is mainly geological and is accompanied by a geological map on a scale of 8 in. to a mile, and by a number of good illustrations. Neither the Tazin nor the Taltson proves to be navigable, except for short stretches, on account of falls and strong rapids. The country abounds in lakes. The lack of soil, apart from climatic difficulties, makes agriculture impossible. The inhabitants are a few nomadic Indians of the Chipewyan and Dogrib stocks.

EFFECTS OF STORAGE UPON COAL.

A FURTHER contribution to the study of the effect of storage on the properties of bituminous coals has been issued from the Engineering Experimental Station, University of Illinois (Bull. 97). Prof. S. W. Parr, who has been associated with Wheeler, Barker, and Kressman in a series of experiments started in 1910, summarises the conclusions arrived at, and records further investigations; more particularly of interest are those on the action of pyrites and the tests of weathered coals under boilers. The general conclusions that freshly mined coal has a large absorptive capacity for oxygen, the degree being dependent on the character of the coal; that the rate of absorption depends upon fineness of division and temperature; that such oxidation leads to slight increase of temperature, and if not radiated more rapidly than generated the action accelerates to a dangerous point (180° F. is named), have for some time been recognised as the main causes of spontaneous ignition. Parr concludes that the well-recognised loss of thermal value on storage is more apparent than real, being largely due to increase of weight due to oxygen absorption.

Much difference of opinion exists as to the part played by pyrites (FeS_2) in promoting heating. Experiments are recorded showing the increase of soluble sulphates in coal of various grades of fineness on storage. Fine grades show marked increase, but only in one case of coal passing a ten-mesh sieve was any increase noted. It is concluded that to lead to sulphur oxidation two conditions are necessary: fineness of division and presence of moisture. It had been previously shown that the oxidation of 0·5 per cent. of sulphur produced sufficient heat to raise the coal, not allowing for radiation losses, about 125° F. Finely divided pyrites, therefore, may well materially assist in promoting heating by itself, raising the temperature to such a point that oxygen absorption is greatly accelerated. It is shown that whilst the heating value of stored coal is materially reduced, such weathered coal gives over-all boiler efficiencies as high as fresh coal, provided a higher draught is used and the fire kept thin and clear of the water-back of the grate, otherwise clinker trouble is experienced.

THE NITROGEN PROBLEM AND THE WORK OF THE NITROGEN PRODUCTS COMMITTEE.[1]

The Nitrogen Problem.

THE war has served to bring into special prominence the fundamental importance of nitrogen compounds, not only for munitions, but also for agriculture.

Nitrogen is an essential constituent of practically all modern explosives, both of the so-called high-explosives and of propellants. The manufacture of the vast quantities that have been called for by the present conditions of warfare has led to an unprecedented demand for various nitrogen compounds.

Nitrogen is also an essential constituent of all vegetation, and the world's production of food is becoming more and more dependent upon the utilisation of nitrogenous fertilisers. The world's consumption of such materials appears practically to double every ten years, and in 1913 had attained the large figure of 2,500,000 tons of Chile nitrate and about 1,400,000 tons of ammonium sulphate.

With the outbreak of war the demand for explosives became of paramount importance, and the requirements of agriculture for the time being took a secondary position. The prospect of a world shortage of food, however, has served to bring the agricultural aspect of the problem again into the forefront. In this connection it is worthy of note that in 1898 Sir William Crookes, in a carefully reasoned statement, directed attention to the possibility of a shortage in the wheat supply of the world and to the vital bearing upon this question of an adequate supply of nitrogenous fertilisers.

The researches of Sir William Crookes and the experimental work of Lord Rayleigh upon the fixation of atmospheric nitrogen by means of the electric arc pointed the way to a method of utilising the unlimited supply of nitrogen in the air, and thus providing against the time when other natural sources of nitrogen compounds should have become exhausted.

The establishment on a very large scale during the past twenty years of processes for nitrogen fixation is one of the most striking electro-chemical developments of modern times. Special reference may be made to the arc process as used in Norway, the Haber or synthetic ammonia process developed in Germany, and to the cyanamide process for the manufacture of nitrolim from calcium carbide as carried on in Norway, Sweden, France, Italy, Germany, and the United States.

In spite of the fact that the incentive to the commercial establishment of nitrogen fixation may be said to have originated in this country, no steps were taken in the United Kingdom to obtain nitrogen compounds other than cyanides synthetically. The ammonia recovered at gasworks and coke-ovens has constituted practically the only form of combined nitrogen produced in this country. During the war the command of the seas has hitherto enabled Great Britain to rely entirely upon importation for the whole of our supplies of nitrate of soda, the most important raw material of our explosives industry. The Central Powers, on the contrary, having been cut off from external supplies, were compelled to fall back upon their internal resources, with the result that nitrogen fixation processes, some of which were established commercially before the war, have been developed upon an enormous scale.

Formation of the Nitrogen Products Committee.

Soon after the formation of the Munitions Inventions Department in August, 1915, proposals for the fixation of nitrogen began to be received from inventors. These schemes were referred to the Chemical Inventions Committee of the Advisory Panel, but as they were isolated applications of the general problem and were of limited scope, they did not immediately lead to any definite line of policy being taken upon the question. The importance of the problem was recognised, however, and the attention of the Minister was directed to it from time to time in the monthly departmental reports.

The inauguration of the submarine campaign in February, 1916, and the grave menace to overseas supplies of nitrates emphasised the importance of taking action on the matter. At this opportune moment a memorandum on the nitrogen problem was submitted to the Department by the Faraday Society. Several conferences were held to discuss the steps that should be taken, and as a result the Nitrogen Products Committee was constituted in the following June. Members of the Advisory Panel, representatives of other Departments of the Ministry of Munitions and of the Government, and delegates of the leading scientific societies were invited to serve. The terms of reference to the Committee were as follows:—

(1) To consider the relative advantages for this country and for the Empire of the various methods for the fixation of atmospheric nitrogen from the point of view of both war and peace purposes; to ascertain their relative costs, and to advise on proposals relevant thereto which may be submitted to the department.

(2) To examine into the supply of the raw materials required, *e.g.* pure nitrogen and hydrogen, and into the utilisation of the by-products obtained.

(3) Since some of the processes employed depend for their success on the provision of large supplies of cheap power, to ascertain where and how this can best be obtained.

(4) To consider what steps can with advantage be taken to conserve and increase the national resources in nitrogen-bearing compounds and to limit their wastage.

(5) To carry out the experimental work necessary to arrive at definite conclusions as to the practicability and efficiency of such processes as may appear to the Committee to be of value.

(6) As a result of the foregoing steps, to advise as to starting operations on an industrial scale.

Nitrogen Fixation Research.

The necessity for research was evident from the outset, and the department at once took steps for the organisation of a suitable research staff and the acquisition of a laboratory. Fortunately, the co-operation of the authorities of University College was secured, and a part of the new Ramsay Laboratory, at that time scarcely completed, was placed at the disposal of the department.

The item placed first on the research programme was a complete investigation into the production of synthetic ammonia by the Haber process. This decision was influenced by the claims made for the process and by the commanding position it occupies in Germany, where the economic conditions as regards coal supplies and the comparative absence of water-power are similar to those in Great Britain. Moreover, the almost complete lack of precise information concerning the commercial details of this process made it apparent that the research would present many unknown factors, and was therefore likely to occupy a considerable time.

Towards the end of the year the Committee came to the conclusion that the ammonia oxidation process was well adapted as an emergency measure for securing quickly a considerable output of nitric acid or nitrates. Although already working with more or less success

[1] Abridged from a Report printed for the Munitions Inventions Department by H.M. Stationery Office.

upon the Continent, the process had not at that time been operated in this country. A systematic investigation of the most recent developments of the process was therefore undertaken.

Many important problems have arisen in connection with the two main researches indicated above. Reference may be made to such questions as the most efficient and commercially practicable catalysts for the synthesis of ammonia and for ammonia oxidation, and the commercial preparation in bulk and at a sufficiently low cost of hydrogen of the high degree of purity required for the synthesis of ammonia.

Interim Report of the Committee.

In view of the magnitude and complexity of the problem, the Committee was unable immediately to present a complete report. Certain definite conclusions had been arrived at, however, and these, together with recommendations thereon, were embodied in a unanimous interim report, which was submitted to the Minister of Munitions in February, 1917. The substance of the recommendations is given below.

(a) *By-product Ammonia.*—The importance of increasing the output of by-product ammonia for munitions and for agriculture was pointed out. Steps were indicated whereby an increase could be obtained from existing gasworks and coke-oven plants. It was also recommended that action should be taken to avoid the loss of ammonia known to be occurring in certain districts.

(b) *Ammonia Oxidation Process.*—The erection at the earliest possible moment of plant capable of producing in the aggregate at least 10,000 tons of nitric acid per annum from gasworks or coke-oven ammonia was recommended.

(c) *Cyanamide Process.*—The erection of a factory having an annual output of the order of 50,000 tons of cyanamide was recommended, the cyanamide to be utilised as such for agriculture or for the production of ammonia.

(d) *Synthetic Ammonia Process.*—The erection of a full-sized trial unit plant for the synthetic ammonia process was recommended.

The Minister of Munitions invited members of the Committee to meet him, and the recommendations of the interim report were discussed in detail. At the conclusion of this meeting the Minister appointed a small Executive Committee to supervise the action involved in giving effect to his decisions, and to report to him from time to time upon the progress made.

The Minister's Decisions and the Action Taken Thereon.

The Minister's decisions were as follows:-

(a) *By-product Ammonia.*—The Committee was requested to deal with the problem of conserving ammonia and of augmenting the output on the lines of the recommendations.

(b) *Ammonia Oxidation Process.*—The Ministry of Munitions would undertake the installation of one Government plant on the lines suggested, or, if the Committee so advised, the Ministry would agree to the erection of plants by suitable private firms. The information resulting from the research work was to be placed freely at the disposal of *bona-fide* manufacturers, but was not to become the exclusive property of any firm or group of firms.

(c) *Cyanamide Process.*—The Committee was requested to investigate the relative merits of a Government scheme and of other schemes that had been put forward involving private enterprise, and to submit a report embodying definite proposals.

(d) *Synthetic Ammonia Process.*—The erection of the full-sized trial unit was authorised.

In carrying out these decisions the Executive Committee dealt first with the problem of conserving and increasing the output of by-product ammonia. The next step taken was to summon a conference of manufacturers likely to be interested in the ammonia oxidation process, as a good deal of useful information had been collected regarding it and the research work had already reached a semi-commercial stage. Encouraging progress continued to be made with the research, and arrangements and plans were made for the erection in London of a trial plant consisting of a single commercial unit designed to give an output of one ton of strong nitric acid per day. At this stage the work of establishing the process on a commercial scale for the manufacture of nitric acid and ammonium nitrate was handed over to the Explosives Department at its request in August, 1917. The work of investigation however, has been continued at the research laboratory as several important aspects of the process still remain to be explored.

With regard to the manufacture of cyanamide, the Executive Committee came to the conclusion that the schemes involving private enterprise did not adequately fulfil the ends in view, and recommended the erection of a factory by the Government. The committee proceeded to collect further information on cyanamide processes in actual operation, and representatives proceeded overseas for this purpose. Complete details of a scheme involving a large-scale factory with electric power station are now in course of preparation for submission to the Minister of Munitions.

Meanwhile a considerable amount of work had been carried out in connection with the synthesis of ammonia, including a detailed investigation of the whole of the conditions governing the process, and of the efficiency and life of numerous catalysts. These studies led to the devising of a method of working whereby the output of ammonia per unit of catalyst space has been increased to a figure which, so far as is known, exceeds anything hitherto attained. The design and erection of a semi-technical unit apparatus embodying a number of novel features, with the necessary pumps, circulators, gas-holders, etc., were then undertaken. It is expected that the operation of this unit, which is now at work, will enable the remaining problems as to the chemical engineering details involved in the design of the full-sized trial unit authorised by the Minister to be definitely settled.

Research upon the preparation of pure hydrogen in bulk has been carried on conjointly with the above investigations, and arrangements have already been made for the trial on a semi-commercial scale of a process that has given very promising results in the laboratory.

Nitrogen in Sulphuric Acid Manufacture.

An important practical outcome of the conferences with manufacturers has been the introduction of ammonia oxidation plant to take the place of the nitre-pots used in the manufacture of sulphuric acid by the leaden chamber process. In pre-war times the annual consumption of Chile nitrate for this purpose amounted to 18,000 tons. With the present increased output of sulphuric acid the consumption is greater, so that the possible saving of overseas freight is appreciable.

One of the small converters designed in, and made for, the Departmental Research Laboratory has been installed at the sulphuric acid works of Messrs. Brunner, Mond, and Co., and has been working satisfactorily for some months. The firm is now arranging to adapt similar converters to the whole of their leaden chambers. The United Alkali Co., the South Metropolitan Gas Co., and others are making arrangements to adopt the process, and are utilising two types of converter to the laboratory designs. Drawings have

also been placed at the disposal of the Explosives Department for the benefit of other controlled establishments.

The apparatus is compact; the expense involved in its installation, apart from ammonia purification plant, is comparatively small, and its operation is simple. Arrangements have therefore been made for the rapid manufacture of the converters likely to be required, since it is believed that these designs may become standard types for the purpose in question. An explanatory pamphlet, compiled by the research staff and embodying detailed information concerning the construction and operation of the converters, will be available shortly for the use of firms which have already taken up the process or are desirous of doing so.

Further Research.

Up to the present date the research has practically been confined to the two processes mentioned above and to problems arising therefrom. The investigations of the Committee have shown, however, that many important and promising fields still remain to be explored.

In present circumstances all activities have been concentrated upon processes which have a possible value as war measures, and no attempt has been made to extend the programme of research beyond such limits. In view, however, of the national importance of the nitrogen problem, both now and in the future, it is hoped that definite arrangements will be made to preserve the continuity of the research after the war.

The Importance of Cheap Electric Power.

It was realised from the outset that the generation of electric power at a cost decidedly lower than has hitherto been attained in this country was a vital factor if an attempt was to be made to establish certain of the nitrogen fixation industries in Great Britain on a sound economic basis from the point of view of post-war competition. A thorough inquiry has therefore been made as to the possibility of cheapening the production of electric power from coal, not only by its generation in bulk with the most modern plant, but also by the use of methods involving carbonisation and gasification, with recovery of the ammonia, fuel oils, and other by-products hitherto wasted when raw coal has been directly used. The sub-committees concerned have had the advantage of obtaining the personal views of a number of experts who attended to give evidence on different aspects of the problem. This inquiry has been distinctly fruitful, and much detailed information has been collected.

Schemes for the utilisation of various undeveloped water-powers in the British Isles for nitrogen fixation have also been submitted and carefully examined. At least one of these schemes for hydro-electric development on a considerable scale presents *prima facie* prospects of becoming a valuable national asset. The Power Sub-Committee recommended that a survey should be made of the drainage area in question with the view of confirming the details of the scheme as submitted. The survey has recently been completed and is expected to result in the formulation of a definite development scheme for the utilisation of this water-power. It is estimated that the engineering work involved will take about two years to complete, and the scheme is therefore to be regarded as a post-war measure.

Costs of Operating Nitrogen Fixation Processes.

Since many of the nitrogen fixation processes have not only a value for munitions, but also a post-war importance, endeavours have been made to investigate the probable requirements of this country for nitrogen products. A detailed examination has been made of the production, consumption, imports, and exports of such products, and special consideration has been given to the question as to the relative order of the costs involved in operating the synthetic and non-synthetic processes.

Most of the information relating to synthetic processes has had to be obtained from foreign sources, and the Committee has been able to secure many figures of an authoritative character. The information thus collected has been subjected to critical examination in the light of manufacturing experience in allied industries, and conclusions have been arrived at as to the costs likely to be incurred under British conditions.

The magnitude of this part of the inquiry may be measured when it is stated that the Committee is in possession of comprehensive data concerning the cost of manufacture of :—

(*a*) Nitric acid and nitrates by the older methods, and by the arc and ammonia oxidation processes;
(*b*) Calcium carbide and cyanamide;
(*c*) Ammonia and ammonium sulphate by the Haber and cyanamide processes;
(*d*) Hydrogen and nitrogen;

as well as concerning the costs involved in operating the Chile nitrate and the by-product ammonia industries.

Nitrogen Fixation in the United States.

The action taken by the United States Government on the nitrogen question is worthy of notice. Under the National Defence Act of 1916 a sum of 4,000,000*l.* was set aside for the establishment in the United States of nitrogen fixation on a large scale. Committees of the National Academy of Sciences, and afterwards of the Ordnance Department, were set up. Their advisers visited England and the more important nitrogen fixation installations on the Continent outside Germany. Upon the recommendation of their experts, the U.S.A. War Department has decided to erect forthwith works for the manufacture of synthetic ammonia by a modified Haber process.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—At the meeting of the council of the University, held on November 21, the following extract from Prof. Cobb's annual report as Livesey professor and head of the Department of Coal-gas and Fuel Industries was read :—"A valuable donation of carbonising, washing, and purifying plant has been promised, which, in the near future, should prove of very great service to the department and the gas industry; but the erection of the plant must await the conclusion of the war. When installed, this plant is intended to serve as a connecting link between the apparatus of the laboratory and plant on the full working scale. It should allow of the production of any quality of coal-gas and water-gas required for experimental purposes, and will, moreover, from the possibility of exact control and ready modification of its parts, allow studies to be made on the influence of varying conditions of operation which it is hoped will be of a high order of usefulness, both for training and research. For this gift the University is indebted to the generosity of Mr. Henry Woodall, jun., who expresses himself in a letter of June 8, 1917, as happy to provide and erect the plant, 'free of cost, to the University in memory of my late father and partner, whose interest in the University was very deep and sincere.'" The council accepted the offer with great pleasure, and expressed its most sincere thanks to Mr. Woodall for his generous gift.

THE annual meetings of the Geographical Association are to be held on January 5 and 7 next at the

London Day Training College, Southampton Row, W.C.1, and at King's College, Strand, W.C.2. At 11.30 a.m. on the first day Mr. Henry Wilson will lecture on the crafts of Britain, past and future, and at 3 p.m. Mr. W. E. Whitehouse will read a paper on map study in geography and military education. A discussion on geography in advanced courses will be held on January 7 at 10.30 a.m.; and at 5 p.m. on the same day Sir W. M. Ramsay will deliver his presidential address on "The Great Goddess, Mother Earth," at King's College.

THE annual meeting of the Mathematical Association will be held at the London Day Training College, Southampton Row, London, on January 9, at 5.30, and January 10, at 2.30. On the first day, Dr. W. P. Milne will deal with the graphical treatment of power series. On the second day the following subjects will be considered:—Dr. W. P. Milne, the uses and functions of a school mathematical library; Dr. S. Brodetsky, nomography; and Mr. G. Goodwill, some suggestions for a presentation of mathematics in closer touch with reality. Prof. T. P. Nunn will give his presidential address at 2.30, on mathematics and individuality, and this will be followed by a discussion on the position of mathematics in the new scheme of the Board of Education for secondary schools.

THE Education Bill introduced by Mr. Fisher in the House of Commons last August has been withdrawn, but a revised Bill, in which certain amendments have been included, is to be brought forward at an early date during the present session of Parliament. "The new Bill," Mr. Bonar Law, Chancellor of the Exchequer, announced on December 13, "will be taken at the earliest possible moment next session, and I have every reason to hope that it may be possible to pass it into law without delay." The educational clauses of the Bill that has now been allowed to lapse have received the approval of most of the associations concerned with the professional work of education in England, as well as of other representative bodies, and the country looks to the Government to begin national reconstruction on the lines laid down by them. The Bill was, however, heavily weighted with certain administrative proposals dealing with the relations between the Board of Education and local education authorities, and it is these which have met with opposition. Mr. Fisher has introduced substantial changes in the new Bill to meet the objections raised to the administrative clauses of the old one. This encourages us to believe that we are within sight of the day when a long-deferred and much-needed measure of reform of our educational system will find a place in the Statute-book. The importance of making provision for the future by strengthening and extending our educational foundations is acknowledged on all sides, and we are glad to be assured by Mr. Bonar Law that the Government intends to facilitate the progress of this measure of reform through the House of Commons.

THE Education (Scotland) Bill was introduced in the House of Commons on December 17, and was read a first time. The main object of the measure is to effect a further improvement in the provision of education for all classes of the population and to make that provision available to residents in remote and isolated districts. It is proposed to raise the age for full-time school attendance from fourteen to fifteen, and to make attendance at continuation classes obligatory upon pupils between the ages of fifteen and eighteen who were not in full-time attendance in school; to restrict employment both before and after school hours of children attending school, and to regulate still further the employment of children or young persons under the age of fifteen in factories and in mines. The local authorities are empowered to provide books not only for children and young persons who are attending school, but also for adult readers, and provision is further made to ensure that so far as is practicable no child or young person who has promise or ability shall be debarred by reason of difficulty of access or want of means from full opportunity for the development of his faculties by attendance at secondary schools or universities. As there is a large volume of opinion in Scotland which favours the setting up of a body representative of universities, local authorities, teachers, and other classes of persons specially interested in education, as a forum for the discussion of educational questions, provision is made for the constitution of an advisory council, designed to assist the Minister of Education and the Education Department in framing educational proposals.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, November 29.—Sir David Prain, president, in the chair.—Dr. H. **Wager**: (1) Intensity and direction of light as factors in phototropism. In this communication an account is given of experiments made to determine the influence of the intensity and the direction of light in effecting phototropic responses in foliage leaves. The distribution of the physico-chemical activities in the photo-sensitive tissues is dependent upon both intensity and direction of light, and since the direction of movement may be determined as the resultant of the varying physico-chemical activities in the whole of the sensitive region, it must be concluded that both intensity and direction of light are necessary factors in the phototropic response. (2) Spore-coloration in the Agaricaceæ. The use of spore-coloration as a basis for the classification of the Agaricaceæ is artificial and imperfect. There is no clear line of demarcation between the various colours, and the designation of the colours in the text-books is very indefinite and unsatisfactory. A beginning has, however, been made by members of the Mycological Committee of the Yorkshire Naturalists' Union to obtain more accurate records of spore-coloration in terms of a standard series of tints. It has been found—and this may be a fact of some considerable physiological interest—that, with one or two doubtful exceptions, all the spore colours so far standardised, whether pink, rusty, or purple, fall within the region of the less refrangible half of the spectrum. Spectroscopic examination also shows this. It has been suggested by Buller that these colouring matters may serve a useful purpose by screening off certain of the sun's rays from the living protoplasm. Spore-coloration may, however, depend, partly at least, upon the kind of substratum on which the fungi grow.

MANCHESTER.

Literary and Philosophical Society, November 27.—Mr. W. Thomson, president, in the chair.—Prof. W. Boyd **Dawkins**: Examples of pre-Roman bronze-plated iron from the Pilgrim's Way. The examples were an iron snaffle-bit, an iron harness-ring, and an iron hub of a wheel, covered with a thin layer of bronze, discovered in 1895, on the site of a village in Bigbury Wood, about two miles due west of Canterbury. The village is of prehistoric Iron age, and is traversed by the Pilgrim's Way, and has yielded a considerable number of implements to be seen in the Manchester Museum. Of these the three above mentioned are of peculiar interest, because they show that the art of plating iron with bronze was known at that remote period, ranging indefinitely backward from the Roman conquest. The

implements found along with the plated articles consist of iron spears, axes, adzes, hammers, ploughshares, billhooks, and sickles, of the types found in settlements elsewhere of the same age, such as Hunsbury, near Northampton, and the Lake Village at Glastonbury. In addition to these there were also fetters and a chain for a chain-gang of six, with six rings to put round the neck. Similar bronze-plated iron articles have been met with elsewhere.—R. L. **Taylor**: The effect of light on solutions of bleaching powder. Experiments were described in which solutions of bleaching powder, differing in concentration and prepared in different ways, were exposed to diffused daylight and to intermittent bright sunlight, while other similar solutions were kept in the dark. Some of the experiments extended over fifteen months. It was found that solutions exposed to sunlight decomposed quite rapidly, those exposed to diffused daylight much more slowly, while dilute solutions (1 per cent.) kept in the dark remained quite unaltered for the whole period of fifteen months. A solution five times the strength of the latter, however, did undergo some decomposition, losing about 20 per cent. of its available chlorine, even when kept in the dark.

DUBLIN.

Royal Dublin Society, November 27.—Prof. Hugh Ryan in the chair.—Dr. F. E. **Hackett** and R. J. **Feeley**: The polarisation of a Leclanché cell. The recovery of a Leclanché cell from polarisation can be analysed into two parts, a rapid recovery and a slow creep towards the initials E.M.F. The period of rapid recovery can be represented closely by an equation similar to the equation for the decay of ionisation in a gas. The recovery of a Weston cadmium cell from short circuit for a brief interval seems also to obey the same law. The disappearance of polarisation is therefore mainly a bimolecular reaction.—Miss E. J. **Leonard**: The genus Tænitis, with some notes on the remaining Tænitidinæ. The paper is an endeavour to place Tænitis in its true phyletic position, and to find out what relationship, if any, it bears to the other genera classed with it, under the heading Tænitidinæ. Tænitis bears a strong external resemblance to Blechnum, and this resemblance is further supported by many points in its anatomy, such as glandular dermal appendages, the venation of the leaf, and the presence of a commisural vein underlying the sorus. Tænitis is therefore classed as a derivative form in the Blechnoid series. Of the remaining genera, the only one which shows definite relationship to Tænitis is Eschatogramme. The others examined—Drymoglossum, Paltonium, Hymenolepis—are widely divergent, probably in accordance with their epiphytic habit.

BOOKS RECEIVED.

A Supplementary Memoir on British Resources of Sands and Rocks used in Glass Manufacture, with Notes on certain Refractory Materials. By Prof. G. H. Boswell and others. Pp. 92. (London: Longmans and Co.) 3*s.* net.

Telegraph Practice. By J. Lee. Pp. ix+102. (London: Longmans and Co.) 2*s.* 6*d.* net.

Studies in the History and Method of Science. Edited by C. Singer. Pp. xiv+304. (Oxford: At the Clarendon Press.) 21*s.* net.

Meteorological Office. British and Magnetic Year Book, 1915. Part iii., Section 2. (London: Meteorological Office.) 10*s.* net.

National Physical Laboratory. Notes on Screw Gauges. By the Staff of the Gauge-Testing Department. Enlarged issue ii. November. (Teddington: W. F. Parrott.) 2*s.* 6*d.*

Cape Peninsula List of Serials. Being a Catalogue of the Publications available for Consultation in the Libraries of the British Medical Association, etc. Second edition. Pp. 55+iv. (Cape Town: South African Public Library.)

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 20.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—A Neglected Chemical Reaction and an Available Source of Potash: E. A. Ashcroft. —Syphoning Gravel: J. Jervis Garrard.

CHEMICAL SOCIETY, at 8.—Vacuum Balance Cases: B. Blount.—Spark-lengths in Hydrocarbon Gases and Vapours: R. Wright.—Studies of Drying Oils. I. The Properties of some Cerium Salts obtained from Drying Oils: R. S. Morrell.—The Relation of Position Isomerism to Optical Activity. XI. The Menthyl Alkyl Esters of Terephthalic Acid and its Nitro-derivatives: J. B. Cohen and H. S. de Pennington.—Diketohydrindene. III.: A. K. Das and B. N. Ghosh.—Synthesis of Pyranole-derivatives: S. C. Chatterji and B. N. Ghosh.—Synthesis of 3:4-Dihydroxyphenanthrene (Morphol) and of 3:4-Phenanthraquinone: G. Barger.

THURSDAY, DECEMBER 27.

ROYAL INSTITUTION, at 3.—Magnets and the Magnetic Compass: Prof. J. A. Fleming.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION, at 3.—Electricity and Electric Currents: Prof. J. A. Fleming.

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THURSDAY, DECEMBER 27, 1917.

EDUCATION AND ORGANISED THOUGHT.

(1) *The Organisation of Thought, Educational and Scientific.* By Prof. A. N. Whitehead. Pp. vii + 228. (London: Williams and Norgate, 1917.) Price 6*s*. net.

(2) *The Human Worth of Rigorous Thinking: Essays and Addresses.* By Prof. Cassius J. Keyser. Pp. 314. (New York: Columbia University Press; London: Oxford University Press, 1916.)

THESE two collections of essays and addresses by Prof. Whitehead and Prof. Keyser contain much matter of considerable interest to the large number of persons who are at present occupying themselves with the consideration of the many difficult questions connected with educational reconstruction. Distinguished scientific, or literary, specialists are not always, perhaps not often, trustworthy guides in educational affairs. Their absorption in a special line of thought is apt to produce in them a bias in regard to the relative values of different branches of study, destructive of that keen sense of proportion which a sound educationist must possess. The specialist is apt to live in a sub-universe of his own, without troubling himself much about the social value of his study or its relations with other parts of the world of thought and action. Even in the teaching of his own subject the specialist not infrequently finds it difficult sufficiently to distinguish between that instruction which is directed to special training and that which is appropriate for forming part of a scheme of liberal education. However, when a specialist has sufficient breadth of mind to enable him to overcome the temptations incidental to his own occupation, he is frequently able to make contributions to educational thought which exhibit an insight greater than is possessed by many of those who approach the problem of education without those advantages which accrue from a profound study of some one department of knowledge.

Both Prof. Whitehead and Prof. Keyser have the advantage of being mathematical specialists with a deep interest in the philosophical aspect of mathematics, and both of them very properly select their illustrations in expressing their educational views from the domain most familiar to them. But Prof. Whitehead, at least, has attained to a certain catholicity of outlook in educational matters which makes his detailed expression of views such as will appeal to many even of those who may not agree with some of his opinions.

(1) Of the two authors Prof. Whitehead remains nearer the solid earth; indeed, his whole treatment of educational questions is permeated by a profound conviction of the importance of education as the means of fitting human beings for life itself in all its phases. He regards education neither merely as the provision of a stimulant to the higher faculties which shall operate as a more or less ornamental and detachable supplement to ordinary life, nor simply as a scheme of training of the kind which aims at producing purely practical efficiency.

One of the most crucial questions which must receive a practical solution in the framework of educational reconstruction is that of the proper relation between liberal or general education and that special or technical study which is necessary in order to fit a student for some definite career. That a failure to make due provision for both these sides of education would be disastrous in its consequences is widely, but, unfortunately, not universally, recognised. Experience has amply demonstrated that a special or technical training is to a large extent a failure unless it is based upon a sound and sufficient general education. The insistence upon this truth has been so frequent that it may be thought to have become a platitude; nevertheless, the pressure of the purely practical side of life is likely to become so urgent in the near future that the danger of education becoming too purely utilitarian in the narrow sense of the term cannot safely be neglected.

In the higher meaning of the expression, Prof. Whitehead is decidedly utilitarian in his view of the aims of education; indeed, the key-note to his ideas about education is struck in his definition of education as "the acquisition of the art of the utilisation of knowledge." Like all statements of a utilitarian flavour, this definition is capable of being interpreted in a narrow or in a broad sense. Its real or apparent defect, that it suggests a too exclusive reference to externality, and lays no stress upon the development of the inner life, may perhaps be held to be removed by means of a sufficiently liberal interpretation of the terms "utilisation" and "knowledge."

In regard to the methods and subject-matter of instruction, Prof. Whitehead emphasises most strongly the importance of not allowing any one branch of study to be treated in such a manner that it is wholly isolated from other departments, and that of exhibiting clearly and continually the relations of all subjects and portions of subjects to one another as parts of a connected and coherent whole; in fact, he holds that "there is only one subject-matter for education, and that is life in all its ramifications." The great practical difficulty in realising such high educational ideals in the actual work of instruction arises from the very insistent demands which modernist methods make upon the skill and energy of the teacher. Failure on the part of a teacher who attempts to teach in accordance with the newer theories is apt to be more disastrous than when the older and more mechanical methods are employed. It is only fair to say that Prof. Whitehead does not attempt to ignore the practical difficulties of this kind which arise when his ideals are carried into the practical domain.

(2) Prof. Keyser, in his essay on "The Human Worth of Rigorous Thinking," and in various other essays on the teaching and philosophy of

mathematics, has much to say which will interest the considerable public whose attention has been arrested by the modern logistic school. His style of writing suffers from being too ornate, and his somewhat overloaded sentences are often a hindrance to a clear comprehension of his meaning.

In their essays on the philosophy of mathematics and on logic both the authors exhibit at times a tendency, common in the school of thought to which they belong, to attach too much relative importance to deductive logic, and even to represent it as being almost the sole form in which rigorous thinking is embodied. Inductive logic, a subject of perhaps greater importance, as lying nearer to the actual modes in which living thought moves, than deductive logic, is apt to be ignored in an estimate of what constitutes rigorous thinking. The reduction of the whole or of parts of mathematics to a purely deductive scheme in which everything flows by chains of syllogisms from a certain body of postulations consisting of existential assumptions and axioms is no doubt of distinct philosophical and æsthetic interest, but it is doubtful whether it can do much to further the progress of mathematics as a living and growing organism.

Mathematical knowledge could not possibly have been discovered by purely deductive processes. The purely deductive form is one in which a mathematical theory can be exhibited only after its completion; it operates as a gauge which tests the exactitude and completeness of what has been discovered by the operation of mental processes of a higher and more subtle kind than those involved in following a chain of syllogisms. Even a purely deductive scheme could not be constructed without the factor of purposiveness in the constructer; in default of a perception of aim, a set of given postulations, definitions, and axioms would be useless. The possession of them would not of itself enable anyone to move a single step in construction, any more than a fount of type would enable a compositor to set up a book if no copy were given to him. It would be unfair to imply that Prof. Whitehead and Prof. Keyser are unaware of these considerations, but at least amongst their disciples of the modern logistic school they are by no means always adequately recognised.

E. W. H.

THE FUNDUS OCULI OF BIRDS.

The Fundus Oculi of Birds, especially as viewed by the Ophthalmoscope: A Study in Comparative Anatomy and Physiology. By Casey A. Wood. Pp. 180+plates lxi. (Chicago: The Lakeside Press, 1917.)

DR. CASEY WOOD is an ophthalmic surgeon with a large practice in one of the busiest cities in America. He is a voluminous writer on subjects connected directly with the science and art of his speciality, and he is the editor of an Encyclopædia of Ophthalmology, of which several volumes have already appeared. It would seem that in this there was enough to provide labour for more than the ordinary day of any man, yet he has found time to devote himself to the exploration of what may almost be described as an untrodden field of science. It is true that in this country Dr. Lindsay Johnson has done work of a similar kind, but he mainly concerned himself with the ophthalmoscopic examination of the mammalian eye. Dr. Wood is the first to make a systematic examination of the fundus appearances in the eyes of birds, and the present volume, with its beautiful series of illustrations by Mr. A. W. Head, is a sufficient proof that it has been a labour of love. The present writer is not in a position to judge whether the ophthalmoscope will prove to be the valuable aid to the classification of birds and the identification of species that Dr. Wood seems to think, but a strong case has been made out for the use of the ophthalmoscope by the ornithologist. For his benefit two chapters are devoted to a description of the ophthalmoscope and its use; but an hour or two with a friendly oculist in the ophthalmic department of a large hospital would do far more than many pages of description to enable those interested in birds to gain a glimpse of this new field.

The most interesting chapters in the book deal with the relationship between the macular arrangements in the retina and the habits of the bird. In these we have a description of all the variations from the almost human-like owl family with simple binocular vision, through the classes which seem to be capable either of binocular or monocular vision, to the purely monocular type with its nasally placed macula. The author differentiates six types of macular arrangement: (1) The amacular fundus; (2) the nasal monomacular fundus, the commonest type in birds; (3) the temporal monomacular fundus, *i.e.* like the human eye and found almost exclusively in owls; (4) the bimacular fundus, with the nasal fovea usually more deeply marked than the temporal fovea, the latter being used in binocular vision and becoming more deeply marked the more the power of binocular stereoscopic single vision is called into play; (5) the infula-macular fundus, where the area of clear vision takes a band-like form, with a well-defined fovea placed nasally to the disc in some part of the band; (6) the infula-bimacular fundus, in which there is a similar band-like area with two foveæ, of which the nasal is invariably in the band, while the temporal sometimes forms an extremity of the band, but sometimes lies above and apart from it.

It would have added very greatly to the scientific value of this work if Dr. Wood had confirmed his description of the macroscopic appearances of these various types by microscopic sections through the macular areas of the principal types. It is obvious that he himself has grave doubts as to the amacular type, and a description of the histological appearances of one specimen from each of the other types would have more than compensated for the loss of several

pages of description of macroscopic appearances.

It is to be regretted that in a work of this character there should appear several slips due to lack of care in revision. On p. 21 it is stated quite rightly that "in birds with more marked binocular vision—hawks, for example—the *temporal* fovea has the greater depth and the eye becomes more asymmetrical"; and further on, on the same page: "Stereoscopic, binocular, single vision in birds with double foveæ . . . is probably accomplished by the two *temporal* foveæ acting in cerebral unison." Yet on p. 56, speaking of the birds of prey in general and the sparrowhawk in particular, the author states that "the *nasal* fovea is invariably the deeper and sharper of the two, and probably is used when distinct sight and binocular vision are required." On pp. 12 and 44 the author uses the term *neurilemma* where obviously he is referring to the *myelin sheath* of the nerve-fibre, and on p. 22 he uses the same term *neurilemma* for the *pial sheath* of the optic nerve. We believe that some physiological writers of past ages did call the perineurium neurilemma, but from the time of Schwann onwards the word has had a definite restriction to the outer sheath of the nerve-fibre, and to that alone.

It is only the interest with which we have read Dr. Wood's book that has led us to note these minor faults, and we must conclude with a note of admiration for the beautifully coloured reproductions of Mr. Head's drawings of the fundi of many different species of birds.

A NATURALIST IN COSTA RICA.

A Year of Costa Rican Natural History. By Amelia S. Calvert and Prof. P. P. Calvert. Pp. xix+577. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 12*s.* 6*d.* net.

PROF. CALVERT, after several prolonged journeys to Mexico and other countries, has extended his entomological studies to Costa Rica, in which State he has spent a whole year, from May, 1909 to 1910, accompanied by Mrs. Calvert, likewise a keen naturalist. Their chief purpose was a study of the dragonflies with reference to their seasonal distribution, which necessitated visits to the same localities at different times throughout the year. These special investigations having not yet been completed (Appendix iii. contains a long list of papers based on the collections, written by the authors and other specialists), their results are deferred, and the present book, embellished with some 150 illustrations, mainly of plants and insects, is devoted to the thousands of observations of all kinds of animals and plants as the travellers came across them. Here lies the drawback of the book; although so full of information, there are but few chapters to be enjoyed by the general reader, who, taking the detail, much of which is unavoidably technical, for granted, would relish some more comprehensive generalised descriptions as characteristic of the country.

Most of their time, about nine months, was spent, off and on, at Cartago, near the capital, San José, situated in the centre of the State, 10° N., at an altitude of some 4700 ft. Cartago is a very important place; there was to have been inaugurated in June, 1910, the "Central American Court of Justice," *i.e.* Carnegie's Peace Palace. From the naturalist's point of view the district was eminently well selected to serve as headquarters, situated as it is on the backbone of the country, at an altitude delightful for a country in the tropics, well watered by numerous streams, well wooded and very fertile, and last, not least, connected by the railway with the Atlantic and the Pacific. Thus they were enabled to make excursions through and into the most diverse kinds of country.

Irazu, the highest volcano, 11,300 ft., now extinct, or rather dormant, like so many Central American volcanoes, is only some ten miles from Cartago. It was visited several times, and on one occasion our naturalists spent a night in the crater with a tent. This chapter, well illustrated with photographs, contains a lively, graphic description of the altitudinal and other charmingly interesting changes.

The Costa Rican Government obliged them by numerous acts of courteous assistance. On several occasions Prof. Calvert was invited to join some Government commission—for instance, to the north-west province—so that he acquired a very satisfactory general knowledge of the middle belt of the country, from the Atlantic to the Pacific.

Costa Rica is a well-to-do farming country; the aboriginal natives give no trouble, and the other mixed and white people have the good sense to keep themselves and their country out of politics. Greatly helped by not a few of the scientific and other residents, everything went smoothly, and there were no stirring incidents of travel to relate until the halcyon year of the conjoint authors was brought to a sudden, catastrophic end.

Earthquakes are endemic in Central America, and more or less disagreeable shocks had been not uncommon at Cartago. Within the last 250 years the town had been destroyed several times. On April 13, 1910, there occurred a few severe shocks, increasing to three dozen by the next day and badly damaging the town; but the disturbance was so local that Prof. Calvert, who happened to be only thirty miles away, did not think it worth while to return to his partner, who was at Cartago. They made the best of the ensuing confusion until May 4, when some sudden, terrific shocks laid the town in ruins, including the Peace Palace, and two days later our lucky travellers, themselves unharmed and without any damage to their numerous collections, left for home.

OUR BOOKSHELF.

Elliptic Integrals. By Prof. Harris Hancock. Pp. 104. (Mathematical Monographs, No. 18.) (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6*s.* net.

INSPIRED by Sir G. Greenhill, to whom he makes due acknowledgment, Prof. Hancock has compiled a very useful monograph, compact, well arranged, and apparently accurate. Chap. i. is on elliptic integrals, properly so called, and their reduction to Legendre's normal forms; it is illustrated by appropriate graphs. Chap. ii. is on the *sn, cn, dn* functions, and gives the period-pavement for each. Chap. iii. gives a well-arranged list of integrals involving elliptic functions. Chap. iv. is on computation, and follows Jacobi and Cayley in the main. It begins with Jacobi's two-circle proof of the addition theorem, goes on to the Landen transformation, and then gives worked-out examples, using the descending scale of moduli (k, k_1, k_2, ...) as Jacobi does. The algorithm of the arithmetico-geometric mean is explained and applied, and there is a particularly neat discussion (p. 79) of integrals of the second kind. There are three tables, all to five places: (i) Complete integrals K, E with $k = \sin\theta°$, and 1° step for $\theta°$; (ii) elliptic integrals $F(k,\phi)$ with k as above, step 5° for $\theta°$ and 1° for $\phi°$; (iii) elliptic integrals $E(k,\phi)$ with k,ϕ as for (ii). All these tables were reproduced from Levy's "Théorie des fonctions elliptiques"; they are well printed and properly spaced.

It is unfortunate that restrictions of space prevented Prof. Hancock from giving any formulæ relating to the first-stage functions $\wp$, $\wp'$. It is true that in numerical applications we have to use a modulus k instead of two invariants, but in many parts of theory Weierstrass's functions are the proper ones to use. G. B. M.

Farm Forestry. By Prof. J. A. Ferguson. Pp. viii + 241. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 6*s.* net.

SCATTERED all over the United States, amidst the farm land, there are numerous small woods, which are in most cases remnants of the original virgin forest. These wood-lots, as they are called, are said to cover in the aggregate as many as 200,000,000 acres. Though, as a rule, poorly stocked with timber at present, the wood-lots are of great value to the rural population, as they provide cheaply the fuel, posts, fencing, and timber required on the farm. Under proper care and management their productive capacity is capable of great expansion, and it is estimated that all the timber necessary for the manifold industries of the United States might be grown on the wood-lots alone. Great efforts are now being made by the Department of Agriculture at Washington and by the agricultural experiment stations in each State to encourage the farmer to take a greater interest in his wood-lot.

The importance of forestry as a subject of instruction in agricultural colleges and in high schools is now universally acknowledged. The present volume is a suitable text-book for agricultural students and for owners of small woodlands, as it covers in a simple way the whole subject of farm forestry. It consists of a series of readable chapters on the economic value of the wood-lot and on the principles of sylviculture as applied to small woods.

The Yearbook of the Universities of the Empire, 1916 and 1917. Published for the Universities Bureau of the British Empire. Pp. xvi + 412. (London: Herbert Jenkins, Ltd.) Price 7*s.* 6*d.* net.

FOR reasons of economy the Yearbook was not published last year. Since the commencement of the war few changes have been made in the regulations of the universities, and the information regarding the conditions of admission, faculties, degrees, scholarships, and publications of the various universities contained in the 1915 issue continue to be substantially correct and are not repeated here. In view of the fact that there are certain matters to which it is forbidden to refer, the part which the universities have taken in national service of all kinds is not summarised in the Yearbook; this subject is postponed until the conclusion of hostilities. Three appendices added to the present volume give full particulars of the Beit fellowships, the scholarships awarded by the Royal Commissioners for the Exhibition of 1851, and the Rhodes scholarships.

The Yearbook provides a very useful summary of university activities throughout the Empire.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Labyrinths in English Churches.

As the author of "Amusements in Mathematics," reviewed in NATURE of December 20, says that he does not know of any instance of a labyrinth in an English church, it may be mentioned that one is represented in one of the bosses of the north aisle of the nave of St. Mary Redcliffe, Bristol. The style is Somerset Perpendicular, the date probably about 1420.

C. S. TAYLOR.

Banwell Vicarage, December 21.

An Optical Phenomenon.

IN physiological laboratories several routine experiments are in use for demonstrating phenomena of the kind described by Capt. C. J. P. Cave (NATURE, December 13, p. 284). These phenomena all support Hering's theory of the reciprocal after-effects of stimulation (see W. H. R. Rivers in Schäfer's "Text-book of Physiology," vol. ii., pp. 1146–47, especially fourth paragraph, p. 1147). The seat of illusion begins at the retina, but (as hinted in my letter on p. 165, November 1) involves all the intricate labyrinth of nerve tissue from the retina to the highest sensory and motor centres.

The way in which the reciprocal after-effects operate in the cases under consideration cannot be fully dis-

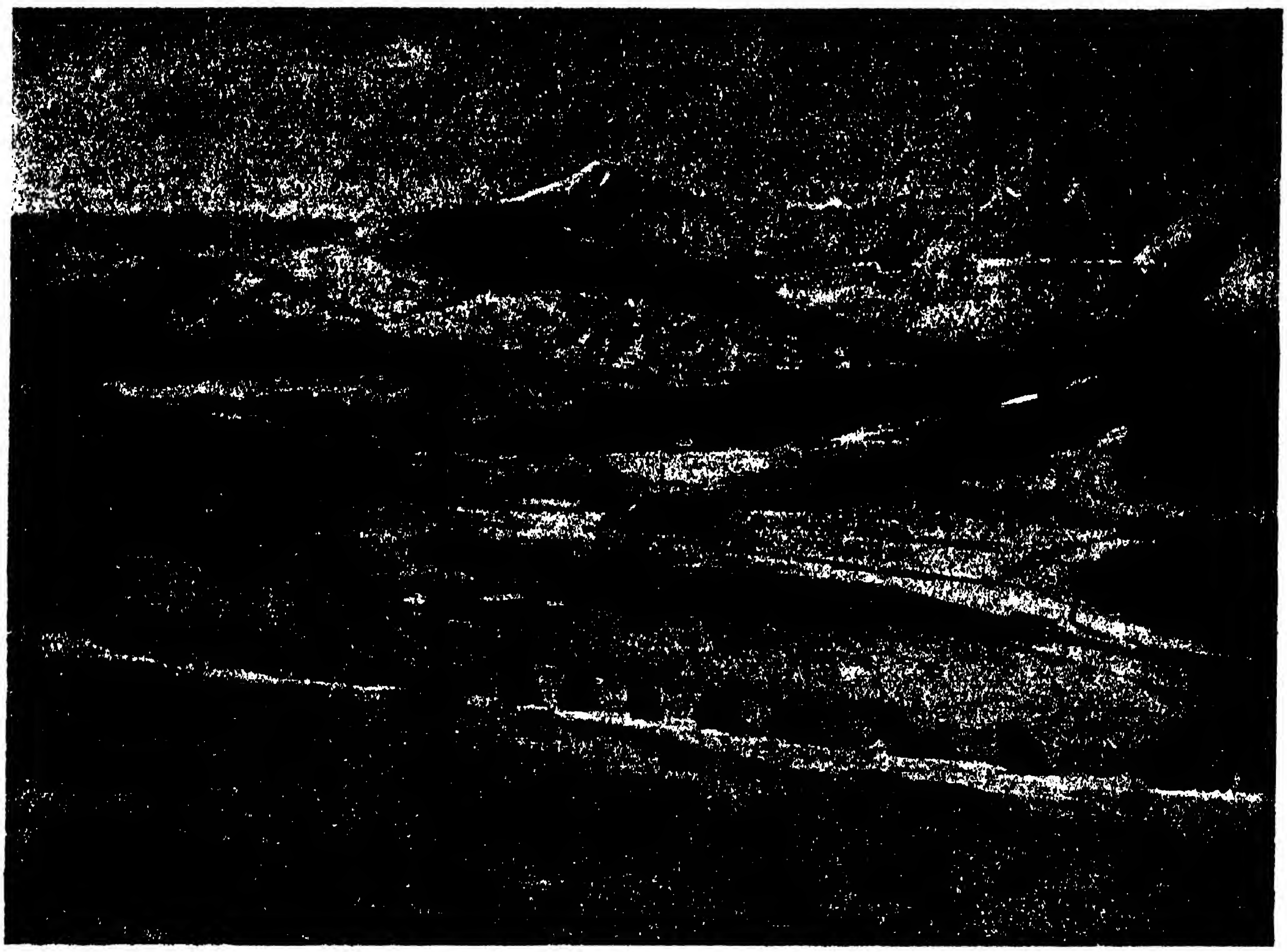
cussed here, but I would make one suggestion. When the objects in a given visual field are moving in different directions, or some of them not moving, the eye usually fixes on one of the objects, regarding it as stationary and treating the others as moving. This requires both a muscular and a nervous effort, involving the co-ordinating mechanism of the higher nerve-centres; and when the stimulus ceases or changes, the reciprocal after-effects in these centres are apparently interpreted as opposite motion; a change of nerve-muscle co-ordination is necessary to accommodate the eye to a changed stimulus. Even very simple sensations may involve complex nerve-muscle co-ordination.

F. J. ALLEN.

Cambridge, December 16.

A TRAVELLER IN LAPLAND.[1]

MR. HEDGES BUTLER is a specialist in unusual modes of travel, and may well be proud of his pioneer work in systematic journeys through the air. Most visitors to Lapland would select the long days of summer, when the heat may prove excessive and the mosquitoes are "a veritable plague." Mr. Butler points out that the best time to start is about the end of March, and he gives pictures of Kiruna railway station, and the romantic little platform at Polcirkel, piled about with snow. When he gets as far north as he can by the steamer or the Narvik railway, he casts aside all British prejudices as to hours of meals and clothing; he dines and dresses like his Lapp companions, sleeps with them in a skin tent when there is no rest-house, and occasionally passes the night in a burrow in the snow. His friendliness with the people smooths away the difficulties of journeys by the boat-like sledges or on skis, and he is always ready to emphasise his happiness rather than his discomfort. In reading his book, we seem admitted to the pleasure of his companionship.



[Photo B. Mesch.

FIG. 1.—Bossekop on the Altenfjord, Norwegian Lapland. From "Through Lapland."

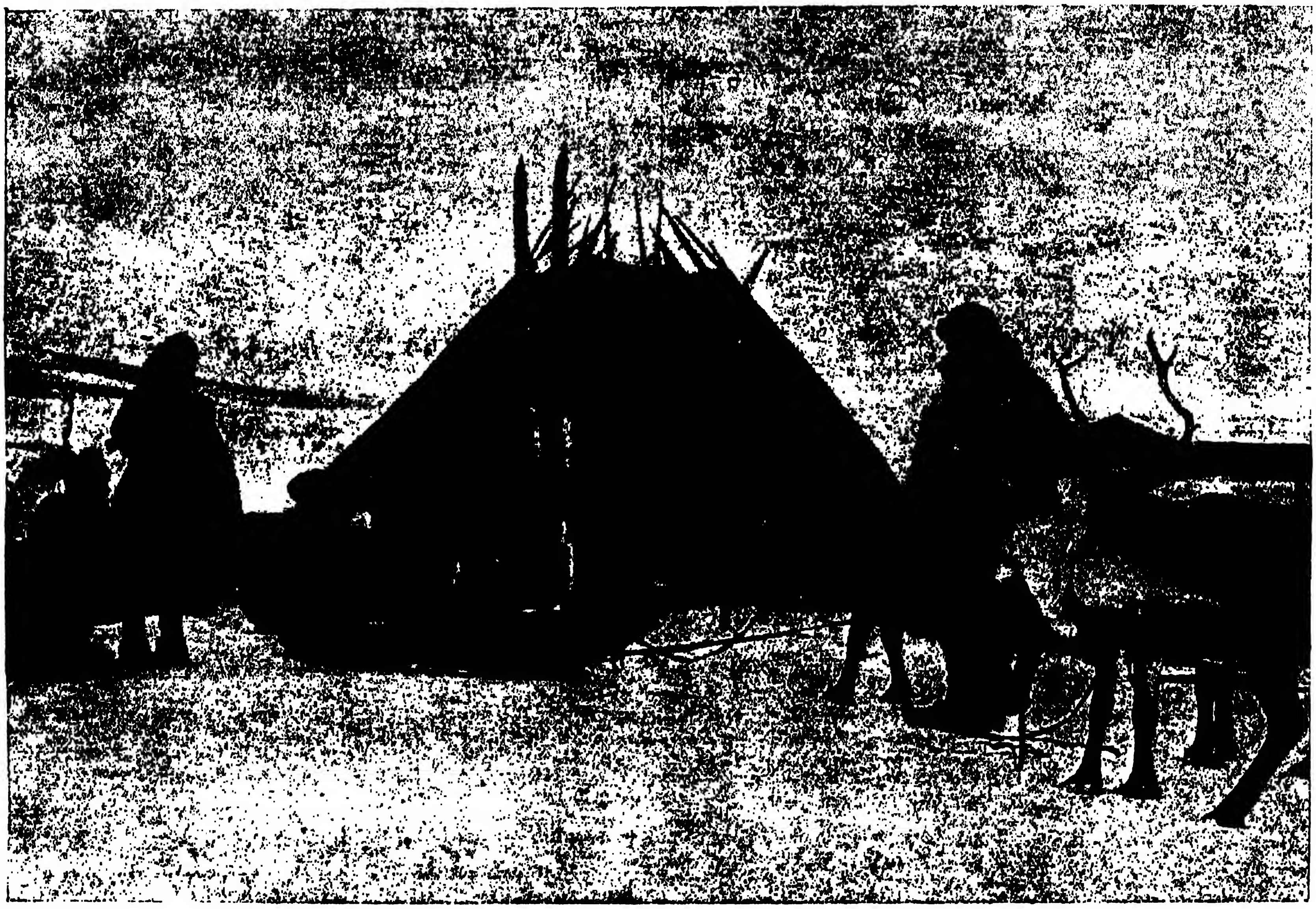
Mr. Butler gives useful details of equipment, which remind us of the delightful "Provision to catch the Whale fish in Russia," published by Hakluyt under the date 1575. He sketches the history of the Lapps, and gives, in chap. vi., a valuable description of the Murman coast and its conditions down to the arrival of the railway at Alexandrovsk. We might reasonably expect, however, some reference to the political and commercial importance of this line, and to the singular revival for London, Hull, and Moscow of the sixteenth-century trading routes. The bibliography of Lapland in Appendix v. begins with Stephanius in 1629; but Englishmen would like some reminder of Willoughby's last journals, and of the tragedy of "the *Speranza,* which wintred in Lappia" in 1553. "Kegor, Pechingo, and Cola" are, moreover, discussed by William Burrough in 1576, and their names were then better known to our merchants than they are at the present day. Mr. Butler will do much to introduce this region again to general readers, and we can only regret that they must turn elsewhere for the romance of our early Russian trade. Burrough uses the pleasant terms "Lappians" and "Lappies" for the people, and we commend these to Mr. Butler, who in one place gives us the odd plural "fjeldlappers" as a Norwegian term.

A certain indifference to language, characteristic alike of British travellers and of soldiers at the Front, shows itself in Mr. Butler's work. The Finnish spellings in the vocabulary on p. 48 are

[1] "Through Lapland with Skis and Reindeer, with Some Account of Ancient Lapland and the Murman Coast." By Frank Hedges Butler. Pp. xii+286. (London: T. Fisher Unwin, Ltd., 1917.) Price 12s. 6d. net.

not those usually accepted, nor will Fru Wiig of Bossekop feel happy in appearing as "Mrs. Wiggs." "Gastivare" (p. 125) is neither Finnish nor Swedish, and "kestikievari" would seem to be the word intended. Mr. Butler, however, can drive reindeer, just as he can follow game in Africa, and the main thing is that he accommodates himself so skilfully to his surroundings. Even if we cannot hope to follow him, and may be content to view the wilds of Lapland from Abisko or the top of Kiirunavaara, we feel something, as we turn his pages, of the dry, healthy air and the crispness of the arctic snow.

GRENVILLE A. J. COLE.



[Photo F. H. Butler.

FIG. 2.—Lapp tent and sledge at Jukasjärvi. From "Through Lapland."

STELLAR DYNAMICS AND STATISTICAL MECHANICS.[1]

THE five papers referred to below do not form a logical sequence of discussion, but are related to one another in that they are all more or less directly concerned with the methods of statistical mechanics and their applications to the problems of stellar dynamics. Since the positions and motions of individual stars are known only in a few instances, it is impossible to treat the motions of stars by the ordinary methods of classical mechanics, so that statistical methods have to be adopted. Important investigations in stellar dynamics have been made recently on this basis by several investigators, more particularly by Eddington and Jeans. There are two fundamentally different methods of treatment: (*a*) The stars may be compared with the molecules of a gas, and the effect of the various encounters considered, the discussion proceeding along the lines of gas theory. (*b*) It may be supposed that the encounters of stars have but small effect, so that the stars may be regarded as describing orbits under the general attraction of the stellar system as a whole, the discussion then proceeding along the lines of hydrodynamics. Both methods may be expected to give results of value for the general theory.

Prof. Charlier has adopted the first of these two methods in (1), and has worked out a kinetic theory for the stars based upon Newton's inverse square law of attraction; in gas theory the treatment has usually supposed either that the molecules are elastic spheres or that they repel each other inversely as the fifth power of the distance.

[1] (1) "Statistical Mechanics, based on the Law of Newton," *Lund Meddelande*, Ser. ii., No. 16. (2) "Ueber den Satz von den Gleichen Verteilung der Energie," *Lund Medd.*, Ser. i., No. 79; *Arkiv för Mat. Astr. och Fysik*, Bd. xii., No. 18. (3) "Ueber hydrodynamisches Gleichgewicht in Sternsystemen," *Lund Medd.*, Ser. i., No. 82; *Arkiv för Mat., etc.*, Bd. xii., No. 21. (4) "Conceptions Monistique et Dualistique de l'Univers Stellaire," *Lund Medd.*, Ser. i., No. 81; *Scientia*, vol. xxii., p. 77 (1917). (5) "Eine Studie über die Analyse der Sternbewegungen," *Lund Medd.*, Ser. i., No. 78; *Arkiv för Mat., etc.*, Bd. xii., No. 10. All by Prof. C. V. L. Charlier.

The latter law is artificial, but was used by Maxwell because it introduced considerable simplification into the discussion. Where stars are concerned it is necessary to distinguish between real collisions and encounters. The latter occur when two stars approach one another sufficiently closely to produce a relative change in path without actually colliding. The number of collisions will naturally be considerably less than that of the encounters. The fundamental general equation of statistical mechanics is formed, and the effect of the collisions and encounters obtained. The discussion follows closely along normal lines. The integration of the fundamental equation when the solution is a frequency-function of type A is performed, the solution being rather more complicated than for Maxwell's law of repulsion. The time of relaxation, which is a measure of the time taken by the system to reach a steady state, is found to be about 10^{16} years. Jeans had previously obtained, by somewhat different reasoning, a value of 10^{14} years, which is of the same order of magnitude.

In (2) some of the results obtained in (1) are applied to prove the law of equipartition of energy for the stars. The proof is elementary and applies only for translational velocities, any possible energy of rotation not being taken into account. As regards translational energy, recent results indicate that the most massive stars have the slowest velocities on the average, and *vice versa,* which is in the sense required by equipartition. But whether there is anything like real equipartition, even for translational velocities, we do not know; still less do we know to what extent the energy of rotation shares in the equipartition. In any case, we should not expect equipartition to hold unless the system had practically reached a steady state, and other evidence must be adduced to settle this point.

In (3) the hydrodynamical analogy is used, the average motion of a small group of stars under the general attraction of the stellar system being considered, neglecting the effects of encounters and collisions on the motion of individual stars. The equation of motion for a steady state is derived from (1) and integrated. The result is obtained that in a star cluster, in which the stars are symmetrically distributed about an axis, in which there is hydrodynamical equilibrium and ellipsoidal velocity surfaces, these surfaces must be spheroids with their axes of rotation perpendicular to the radius vector from the centre of the cluster. The same result had previously been obtained otherwise by Jeans. It was proved by Schwarzschild that the velocity surfaces are approximately spheroids with their rotation axes directed towards the *vertex*. Jeans, through insufficient evidence, had concluded that this direction was not perpendicular to the radius vector. On the other hand, Prof. Charlier, on the evidence afforded by recent investigations at Lund, concludes that the two directions are perpendicular. Jeans has since accepted the evidence on which Prof. Charlier bases this conclusion. The result supports, but does not prove, the supposition that our stellar system is in such equilibrium, for there are other factors to be taken into consideration.

In (4) Prof. Charlier discusses and compares what he calls the monistic and dualistic conceptions of the stellar universe. According to the former, the universe can be considered as a single system which, if it has not actually attained a steady state, is on the way to doing so. By the latter he means the hypothesis that there are two intermingling star-streams, though it is doubtful whether the originators of that hypothesis ever conceived that there were two streams of stars approaching and passing through one another. Our knowledge of stellar motions is derived almost entirely from the nearer stars, and it would be dangerous to make so sweeping an assertion. Reasons are advanced by Prof. Charlier for supposing that the methods of statistical mechanics as developed in (1) can be applied to the monistic conception, and an endeavour is made to show that the state of motion in our system is comparable with the results given by the kinetic theory. The time of relaxation obtained in (1) was thought by Jeans to be too long for our system to be considered as yet in a steady state. Prof. Charlier brings forward evidence to show that the velocities of the stars are in qualitative agreement with the requirements of the kinetic theory [see (2)], and that red stars are more nearly in statistical equilibrium than the younger blue stars. The results obtained in (3) also supported the idea of a steady state. To Eddington's difficulty of believing that the evidence of scattered clusters of stars moving with a common velocity, such as the Ursa Major cluster, can be explained if the chance attractions of stars passing in the vicinity have an appreciable effect on stellar motions, Prof. Charlier replies that it is possible that such clusters are but the remnants of much larger clusters, most of the members of which have succumbed to encounters with other stars by the way. The sparseness of the stars in these clusters may be held to support this view. Furthermore, Jeans has shown that a compact globular cluster moving through another mass of stars will be spread out into a disc-like arrangement, perpendicular to the direction of motion. The conditions of Jeans's discussion cannot be exactly reproduced in the stellar universe, but it is interesting to note that Turner has shown that the Ursa Major system has approximately this shape.

The fifth paper is a valuable discussion of the various methods which have been used for analysing stellar motions, and forms a convenient summary for purposes of reference. The analysis on the simple hypothesis of a single star-stream, on that of two star-streams developed by Kapteyn and Eddington, on the ellipsoidal hypothesis of Schwarzschild—all of which are based upon the directions of the motions only—and that on the correlation methods developed by Prof. Charlier himself—in which both the magnitude and direction of the motions are taken into account—are discussed and illustrated by application to one particular region of the sky. H. S. JONES.

PROF. FRANKLIN P. MALL.

ALL who are interested in the progress of biology will learn with deep regret of the sudden death of Dr. Franklin P. Mall, of Johns Hopkins University, at the age of fifty-five. It was chiefly owing to his precepts and example that, in little more than a score of years, a complete revolution was wrought in the anatomical departments attached to medical schools throughout the length and breadth of the United States. Dissecting-rooms were changed from places in which routine teaching and perfunctory investigation were carried on to laboratories where exact methods were applied to the elucidation of definite problems. Prof. Mall was thirty-one years of age when he returned in 1893 from a long course of study under the late Prof. His, of Leipzig, to become the first professor of anatomy in Johns Hopkins University, Baltimore. He designed his own department, selecting a slimly built, cheap, brick construction, and settled down with his students to combine study with research. He devoted himself to embryological and microscopic investigations, reconstructing his results in the exact model methods practised by Prof. His. His writings cover the whole field of embryology, every contribution representing a permanent addition to knowledge. His pupils left him to fill the various chairs of anatomy as they fell vacant, and carried to their new departments the methods and spirit they had imbibed from Franklin Mall. He took a leading part in the foundation of the excellent journals which have been established in the United States for the publication of anatomical investigations—the *American Journal of Anatomy*, the *Anatomical Record*, and the *Journal of Morphology*. He pursued the study of human embryology in a more systematic manner than has ever been accomplished by any other man.

Prof. Mall began to collect embryos in the earlier months of development when he settled in Baltimore, and continued year by year to preserve, register, and photograph them; they were cut into serial sections, examined, reconstructed, and methodically stored, so that student after student could use the same sections for researches of quite different kinds. By 1913 his collection of embryos numbered more than 1000, many of them showing early stages of diseases and malformations. When he succeeded in persuading the Carnegie Institution of Washington to establish a National Department of Embryology, he handed over to it the whole of his embryological collection and accepted the post of director of the department. The names of the workers he enlisted in the service of the department, and the great scientific value of the "Contributions to Embryology," issued by the Carnegie Institution, are ample evidence of the success of his last piece of statesmanship.

Prof. Mall was a quiet, kind, and charming man, who had set himself a public-spirited but arduous task, and he lived long enough to see it well begun and to leave behind a band of pupils who are willing and able to carry it on.

NOTES.

PROF. A. G. NATHORST, of Stockholm, having on November 7 last reached sixty-seven years of age, has, in accordance with Swedish laws, retired from his appointment as keeper of the palæobotanical department of the Swedish State Museum of Natural History (Naturhistoriska Riksmuseum). His successor has not yet been appointed.

THE efforts of Sir Harcourt Butler in developing the mineral resources of Burma have been successful. There are prospects, says the *Pioneer Mail* of November 3, that the production of wolfram in Tavoy will soon be largely increased. One or two mines which until recently were cut off from communications are now being developed, and promise an outturn of 30 to 40 tons per month. Some rich new finds have been made in old blocks, and with the new road to the Pe Valley belt, extensions of present roads, and rumours of the promotion of new companies in England, the prospects of the industry have much improved.

THE council of the National Museum of Wales is devoting special attention to the insect collections. Six thousand specimens, of which a large proportion are Welsh examples, have been classified. Experiments as to the best methods of mounting and preserving small-winged insects and larvæ are being carried out. There are still, however, several groups almost unrepresented, and an appeal is made to collectors to add any specimens of interest, so that Welsh entomology may be adequately represented.

Two pamphlets on the Channel Tunnel have reached us—one by Mr. Arthur Fell, chairman of the House of Commons Committee on the question, the other by Sir Francis Fox. Mr. Fell strongly criticises the Government for refusing to allow any preliminary steps to be taken by the Channel Tunnel Company. He not only dwells on the economic and military value of the tunnel, but also emphasises the political aspect of the problem. Sir Francis Fox's pamphlet is a reprint from the *Geographical Journal*. It deals with the engineering aspects of the tunnel. The tunnel is designed to keep within the grey chalk, except near the two coasts, where for a short distance it passes through the gault. The depth below the sea-bed is to be a minimum of 100 ft. The tunnel will consist of two tubes, each 18 ft. in diameter, with cross-tunnels every 200 yards. It is proposed to form a "water lock," a dip in the tubes, which could, in case of emergency, be filled with water for the length of a mile. The water would not injure the tunnel works, and it could be pumped out only by the machinery at the power station in Kent. Trains could run between London and Paris *via* the Channel Tunnel in six hours.

WHEN a person feels that the air of a room is dry and oppressive the feeling is generally explained as due to the relative humidity or fraction of saturation of the air being low. The erroneous character of this explanation was pointed out two years ago by Dr. Leonard Hill and his colleagues of the Medical Research Committee in a communication to the Royal Society. They ascribe our sensation to the rate of loss of heat from the skin by evaporation, and have constructed a thermometer with a large bulb covered with moist fabric to measure this rate of loss under different conditions as to temperature, saturation, and speed of motion of the air, the bulb being kept at about the temperature of the human body. The agreement between the instrument and the "feel" of the air is found to be fairly

close. The subject has been carried a stage further by the work of Mr. G. T. Palmer, chief of the research staff of the New York Commission on Ventilation. He finds that our sensation is due, not to the rate of evaporation from the surface of the body, but to the difference between that rate and the rate of supply of moisture from the interior of the body to the skin. His paper will be found in the July number of the Journal of the American Society of Heating and Ventilating Engineers.

IN the December issue of *Man* Mr. A. C. Breton describes, with a photograph, a curious scene from a painted pot found in a mound in British Honduras, and now in the Liverpool Museum. It represents a group of strange winged creatures which appear to be dancing and singing for joy at the coming of vegetation, represented by a seedling in the corner. The humming-bird was the special messenger of the sun to awake and encourage vegetation, and appears prominently in this group. It would seem a natural result of watching the migrating birds in spring that man should endeavour to imitate them in his ceremonial dances. Similar dances have been noticed in Queen Charlotte Islands, and the gestures of the creatures on this pot may be compared with those on British Columbian totem poles.

CO-PARTNERSHIP in nests, and presumably in the duties of incubation, is known to exist, at any rate sporadically, among many birds. Mr. J. Wiglesworth, in *British Birds* for December, records several cases of this kind among sheldrakes breeding on Steepholm, an island in the Bristol Channel. In one nest which he examined he found the eggs of no fewer than five birds. The frequency of this occurrence on this small island may perhaps be due to the limited nesting accommodation. This record, by so competent an authority, will be welcomed by ornithologists.

WHALERS know well the excellent qualities of whale-meat, but doubtless the general public would need some persuasion to adopt it as a substitute for beef. A writer, however, in *California Fish and Game* for October suggests that, in present circumstances, a trial should be made. He proposes to begin with the Californian grey-whale (Rhachianectes), the carcass of which yields about twelve tons of most succulent "beef." Some, both in a fresh state and canned, has already been placed on the market, and it is to be hoped that success will attend the venture, for in this case it may lead to sane methods of conservation. At present whaling is being carried on utterly regardless of the future, so that unless something is done speedily the whales will follow Steller's sea-cow and many another valuable species which has fallen a prey to commercial "enterprise."

DR. EAGLE CLARKE, in the *Scottish Naturalist* for December, continues his most interesting analysis of wild life in a West Highland deer forest. All students of our native fauna will be grateful for this contribution, especially as very little has yet been done in regard to altitudinal distribution. Over the area surveyed the fox is very numerous, at from 900 ft. to 3500 ft., while the badger, which seems here almost extinct, ascends no higher than 1500 ft. A few pairs of otters are to be found on Lochs Ossian (1269 ft.) and Treig, and on the river Ghuilbin. Formerly it frequented Loch na Lap (1930 ft.), but has not been seen there for some years. Many will probably be surprised to learn that the house-sparrow has but recently penetrated to these fastnesses, having followed the iron road into the Highlands. It is now resident at Corrour Station, at the summit of the West Highland Railway (1350 ft.). Thence it has established further outposts, but it has not yet reached Loch Treig.

AN able history of the bats of Central Africa is given in an article in the Bulletin of the American Museum of Natural History, vol. xxxvii., 1917. The authors, Messrs. J. A. Allen, H. Lang, and J. P. Chapin, therein describe the material obtained by the American Museum Congo Expedition. Naturally, a considerable number of new species are described, but the value of the communication rests not so much on this as on the light it throws upon the life-histories of these animals, and the many remarkable structural modifications and secondary sexual characters which the authors have here brought together. Some of these were already known, but the range of these peculiarities has been enlarged by many striking additions. One of the most important of these concerns the air-sacs of that singular creature, the hammer-head bat. But the authors offer no comments on the function of the large cheek-pouch of this animal, though they give an excellent figure indicating its great size.

IT has long been known that true bats existed among the earliest Tertiary mammals, but remains are very rare, and nothing has been discovered of the ancestry of the group. An imperfect skull of a new genus, Zanycteris, has now been obtained from one of the oldest Tertiary formations (Wasatch) in Colorado, U.S.A., and according to a description of the specimen by Dr. W. D. Matthew (Bull. Amer. Mus. Nat. Hist., vol. xxxvii., pp. 569–71), it seems to represent a highly specialised member of the family Phyllostomatidæ, which is still peculiar to tropical America. The skull is only unusual in the length of its slender snout and the comparatively small size of its canine tooth. Numerous comparatively modern fossil remains of bats have also lately been received by the American Museum from the caverns of Porto Rico. Among them one skull is especially interesting as belonging to the genus Phyllonycteris, of which only one species is known living in Cuba (H. E. Anthony, Bull. Amer. Mus. Nat. Hist., vol. xxxvii., pp. 565–68, pl. lvi.).

THE fishes of the fresh waters of Panama are described with great care and detail by Messrs. S. E. Meek and S. F. Hildebrand in vol. x., No. 15, of the zoological series of publications of the Field Museum of Natural History, Chicago. Though small collections of the fish-fauna have from time to time been made by tourists and others, no serious survey of the waters of the canal zone had been made until that organised co-operatively by the Smithsonian Institution, the Field Museum of Natural History, and the U.S. Bureau of Fisheries. The present memoir contains the results of this ichthyological reconnaissance. The need for such a survey was urgent, since it was not begun until much work had been done on the canal and natural conditions had already been considerably disturbed, but it was fortunately completed before the species of the two slopes had been allowed to intermingle. Before the survey began the Rio Grande, on the Pacific slope of the canal zone, had been thoroughly cut to pieces, and hence to measure the probable effect of this disturbance it became necessary to extend investigations to other streams east and west of the Rio Grande. As a consequence, data were collected which seem to show that several species have disappeared owing to the unfavourable conditions created by the construction of the canal. Five genera and thirteen species new to science are described in these pages, which, further, are illustrated by numerous excellent plates.

THE Smithsonian Institution has issued an elaborate monograph on "The Comparative Histology of the Femur," by Dr. J. S. Foote, professor of pathology in Creighton Medical College, Omaha, Nebraska (Smithsonian Contributions to Knowledge, vol. xxxv., No. 3, 1916). Prof. Foote's investigations commenced in 1909, when he casually observed, in a section of a turkey's femur, "a type of bone structure quite unlike that usually described." He therefore began a systematic investigation of bone structure as revealed by sections across the femoral shaft. In his monograph he gives descriptions of the sectional appearance of 440 femora—amphibian, reptilian, avian, and mammalian. Prof. Foote is of opinion that we must recognise not one, but three types of architecture in the minute structure of bone. In the type with which most students are familiar the bone is arranged in concentric systems—Haversian systems—in the centre of each of which there is a vascular channel. The Haversian is the commonest system in higher mammals. The more usual system in birds is quite different. In them the bone is arranged in laminæ, with vascular channels between the laminæ. A more primitive system than either the Haversian or "laminar" is what Prof. Foote describes as the "lamellar"—best seen in the femora of amphibians. In this type the bone is arranged in a series of lamellæ surrounding the medullary cavity, but there are no vascular channels either within or between the lamellæ, as in the two more highly evolved types of bone.

A LIST of the Hemiptera-Heteroptera of New England has been published by Mr. H. M. Parshley as an "Occasional Paper" (No. 7) of the Boston Society of Natural History. The list is prefaced by some suggestive distributional notes, in which the author points out that most of the species common to Europe and North America appear to be "massed" on or near the eastern seaboard of the latter continent.

WHILE studying the collection of fishes of the Academy of Natural Sciences of Philadelphia, Mr. H. W. Fowler discovered many interesting specimens from New England waters. These he describes in the Proceedings of the Boston Society of Natural History (vol. xxxv., No. 4). Three of these species are new to science, and one of them represents a family and genus hitherto unknown in New England waters. Some excellent text-figures add much to the value of this contribution.

AN interesting paper on recognition among insects is published by Dr. N. E. McIndoo (Smithsonian Miscell. Coll., vol. lxviii., No. 2), in which he summarises our knowledge of scent-producing organs among insects of different orders, and the responses made by various creatures to such chemical stimuli. A considerable section of the paper is occupied by an account of Dr. McIndoo's own experiments on the characteristic odours emitted by different hive bees—queen, drones, and workers of various occupations. The economic importance of the study of the reactions of insects is pointed out with many apt illustrations in Dr. C. Gordon Hewitt's recent address on insect behaviour as a factor in applied entomology (*Journ. Econ. Entom.*, vol. x., 1917, No. 1). Messrs. E. A. McGregor and F. L. McDonough, in Bulletin 416 of the U.S. Department of Agriculture, on the red "spider" of cotton (*Tetranychus bimaculatus*), give much attention to the mite's means of dispersal and its responses to seasonal and environmental change.

IN part 4 of vol. vii. and part 1 of vol. viii. of the Bulletin of Entomological Research, Prof. R. Newstead continues his "Observations on Scale-insects," describing several new species, and giving welcome figures of the little-known male of the common *Lecanium hesperidum*. In the latter number the Rev. J. Waterston has a noteworthy paper on a new species of Paraphelinus, a genus of small Hymenoptera, the larvæ of which feed in the eggs of grasshoppers. Drs. A. Ingram and G. W. Scott Macfie give structural details of the pupæ of West African mosquitoes. Mr. Rupert W. Jack, of Southern Rhodesia, brings forward evidence which has convinced him of the occasional transmission of trypanosomiasis by blood-sucking flies other than the tsetses (Glossina), such as tabanids and Stomoxys. There appear, however, to be limits to the spread of disease by such means, as they "have not resulted in *establishing* trypanosomiasis in any area away from the fly-belts." The *Review of Applied Entomology*, with its invaluable summaries, is now in its seventh volume, and a highly useful subject-index of the agricultural entries in the first three volumes, compiled by Mr. S. A. Neave, has just been published by the Imperial Bureau of Entomology.

A PAPER of special interest, literally "breaking ground" in a direction hitherto little worked in these countries, is Dr. A. E. Cameron's "Insect Association of a Local Environmental Complex in the District of Holmes Chapel, Cheshire" (Trans. Roy. Soc. Edinb., vol. lii., part 1, No. 2). Several American naturalists have lately given attention to the intensive faunistic and associational study of small areas, and Dr. Cameron has done the same kind of work for this small corner of north-western England with great care and thoroughness. The relations between the insects found and the ecological types of vegetation in the two meadows specially examined are pointed out. A feature of agricultural interest was noted in the dominance of crane-fly larvæ as root-feeders in one meadow and of "wire-worms" in the other. The paper represents a vast amount of systematic and statistical work, and it is to be hoped that, as Dr. Cameron has now transferred his activities to Canada, other of our entomologists may be incited to try similar lines of inquiry.

SEVERAL improvements in maps designed to show economic distributions are suggested in a paper by Mr. George Philip in the *Geographical Journal* for December (vol. l., No. 6). Mr. Philip has attempted, with a considerable measure of success, to give effect to the recommendations of the British Association committee's report on maps for school use. He has avoided peppering the map with symbols or names for the distribution of natural products, commercial commodities, or industries, and has restricted their use to coalfields and a few important natural products. Names are further reduced by giving only the initials of ports. The groundwork colouring is a combination of density of population and the type of vegetation. In the most densely populated regions distinction is made, by two tints of red, between highly developed manufacturing enterprise and horticultural or plantation industries. The other productive regions are shown in shades of green, and undeveloped regions in brown. The map thus indicates the present state of economic development. Only the most important trade routes are shown by land and sea; on the sea by bands the width of which varies with the volume of trade. Mr. Philip proposes a school atlas on these lines, with the continents on a scale of one to forty millions, except Europe, which would have a scale of one to ten millions. A specimen map of Eurasia accompanies the paper. Finer colour printing would improve this striking map.

A PAMPHLET by the late Prof. Henrik Mohn, "Der Luftdruck zu Framheim und seine Tägliche Periode" (Christiania: Jacob Dybwad), deals with the pressure at Framheim, lat. 78° 38′ S., long. 163° 37′ W., the most southerly meteorological station on the earth, established by Amundsen as his winter station during his Antarctic expedition. The observations were taken daily from April 1, 1911, to January 29, 1912, at 8 a.m., 2 p.m., and 8 p.m. local mean time, from a Kew pattern station barometer hung on a wall of the kitchen of the hut. A Richard barograph was also installed close to the barometer, and a Wild-Fuess barometer was kept, but the readings were not used for the computations, as they were not so trustworthy as those of the Kew pattern barometer. The height above sea-level of the barometers was 11·1 metres. Hourly values for each hour of the whole period are given, together with means and deviations. The pressure appears to vary from between about 710 and 765 mm., and the monthly means show a maximum of 753·23 mm. for December and a minimum of 726·60 mm. for October. The figures are also given for harmonic analysis, and the pressures of the different seasons are compared.

KOREA (Chosèn) has developed a thoroughly systematic series of meteorological stations, and recently the results of observations for the lustrum 1911–15 have been compiled at the Meteorological Observatory of the Government-General of the peninsula. The shores are washed by the Yellow Sea and the Sea of Japan, and the geographical surroundings render it comparable in many ways with those of Italy. Observations are published for nine stations, fairly well scattered over Korea, and extending from Syeng-chin in the north to Mokpo in the south. One-half of the stations commenced observing in 1904, so that results are available in these cases for fourteen years. Pressure results at the several stations agree remarkably well *inter se*, which shows great care in the organisation, and the corrected mean for all stations combined, for the lustrum, is about 30 in., which agrees admirably with the mean value for the year given by the Meteorological Office on its mean pressure chart, given in a recently published barometer manual. Practically all meteorological elements are dealt with for the lustrum and for each station. For the several stations the monthly means are given deduced from four-hourly observations, for which the values are also printed for the several elements, so that most valuable details are available. Five-day means are also given for the various data.

THE double compounds of the metallic halides with ether hitherto known are those with glucinum and titanium chlorides and with aluminium, mercuric and stannous bromides. The Journal of the Chemical Society for September contains a description by Messrs. A. Forster, C. Cooper, and G. Varrow of the preparation of double compounds of ferric chloride with ether and with benzyl sulphide. The former compound, $C_4H_{10}O,FeCl_3$, obtained by the interaction of anhydrous ferric chloride and dry ether, is a dark red, highly deliquescent solid soluble in benzene, but decomposed by alcohol or water. When heated it evolves pure ethyl chloride. The substance in ethereal solution reacts with dry ammonia, giving brick-red, amorphous compounds of varying composition. Benzyl sulphide ferric chloride, $(C_7H_7)_2S,FeCl_3$, obtained by mixing ethereal solutions of its two components in molecular proportions and allowing to stand for some hours, forms minute lemon-yellow crystals soluble in chloroform and slightly so in alcohol, but insoluble in ether or acetone. The crystals rapidly become brown on exposure to moist air, this reaction distinguishing them from tribenzylsulphinium chloride ferrichloride. Benzyl sulphide ferric chloride is slowly decomposed into its two constituents by water; with alkalis the products are benzyl sulphide and ferric hydroxide. If a solution of equimolecular proportions of benzyl sulphide and cyanide in dry ether is added to an ethereal solution of ferric chloride, tribenzylsulphinium cyanide ferrichloride, $(C_7H_7)_3SCN,FeCl_3$, is formed. This substance is obtained as lemon-yellow crystals insoluble in ether, but soluble in alcohol and chloroform. When treated with excess of ammonia in alcoholic solution the substance gives tribenzylsulphinium cyanide, $(C_7H_7)_3SCN$, which forms large white prisms, m.p. 41°, readily soluble in organic solvents, but only slightly so in water. In contact with water the cyanide completely dissociates in a few hours.

THE solving of formulæ involving more than two variables by means of curves, alignment charts, isometric charts, etc., is now well known, and a good deal has appeared recently on these methods. Special slide rules have also been employed to a large extent, and are designed to solve problems connected with special trades. The first instalment of an article on the design of special slide rules, by Mr. A. Lewis Jenkins, appears in the *Engineering Magazine* for November, and contains much that will be of interest to any who may be called upon to produce a special instrument of this type.

OWING to the failure of several reinforced concrete floors in the United States within ten or a dozen years of their construction, Prof. H. J. M. Creighton, of Swarthmore College, has examined a large number of reinforced concrete structures in which cracks were developing, and gives the results of his investigations in the Journal of the Franklin Institute for November. He finds that in every case the cracks run along the reinforcing rods, and are due to the deteriorating action of salt and brine on the concrete. Solutions of the chlorides react with the lime and the silicates in the concrete, and penetrating to the iron of the reinforcement convert it into oxide and hydrate, which occupy more space than the metal and force the concrete apart. It is therefore necessary to waterproof reinforced concrete structures which will be in contact with brine, to cease to use in the concrete beach gravel which has not been thoroughly washed with fresh water, and never to add salt to the concrete to prevent it freezing during building operations in cold weather.

AN interesting article on gear planers appears in *Engineering* for December 14. The most remarkable advance which has been made in the formation of the teeth of gear wheels is in the substitution of methods of generation for those of form-cutting. The principle is simple, and the results are precise. A master gear, either a rack or a pinion, imparts the correct shapes to the teeth of any gears of the same pitch. The basis tooth is that of the rack, with flanks having a predetermined pressure angle. This may be embodied in a worm-like hob; or a rack tooth can be used to generate a master pinion; or the tooth may be employed directly as a cutter; or several teeth can be included in a length of rack, sufficient in number to make contact with all the teeth that can be in mesh with the largest wheel to be generated in the system. The relative movements of the cutter and the blank are identical with those that will occur in the actual rack and its generated gear. Wheels produced thus will engage correctly with the rack and with each other, and require no corrections or easing. The cutter is fed

tangentially to the gear blank in the intervals of the reciprocations of the cutter across the face of the blank. This is the principle adopted in the Sunderland generating spur-gear planer, manufactured by Messrs. J. Parkinson, of Shipley, and the article cited contains a fully illustrated description of this machine.

OUR ASTRONOMICAL COLUMN.

COMETS.—*Popular Astronomy* for November contains particulars of the appearance of Wolf's comet during the autumn. On October 15 it was readily visible in a 5-in. finder, with a small central non-stellar condensation of the 12th magnitude.

Prof. V. M. Slipher photographed its spectrum at Flagstaff on August 25 and 26. The spectrum was chiefly continuous, even the strongest cometary emissions being faint; traces were seen of the cyanogen band at 3883, and of the hydrocarbon band at 4737. The spectrum was too narrow and faint to show the solar lines, but it was evident that the comet was shining almost entirely by reflected sunlight. This is not surprising, considering its great distance from the sun.

Mr. Viljev has made the unexpected discovery that the object photographed in September, 1916, which was announced as Encke's comet near aphelion, was not really that comet; there are thus at least three occasions (January, 1908, September, 1916, September, 1917) when a faint object was detected, nearly in the right position for the comet, and with nearly the right motion, and yet proving to have no connection with it. It brings forcibly before us what a large number of unknown faint objects (comets or minor planets) exist in the solar system. Mr. Viljev has taken over the computations relating to this comet that were formerly in Prof. Backlund's hands.

The following ephemeris has been calculated from Mr. Viljev's approximate elements. Perihelion passage will be 1918 March 24·313 G.M.T. E is the eccentric anomaly.

G.M.T. 1918	E. °	R.A. h. m. s.	Decl. N. ° ′	log r	log Δ
Jan. 1·416	−70	23 0 54	3 24	0·1976	0·2223
6·086	68	23 5 8	3 41	0·1804	0·2221
10·574	66	23 9 44	4 1	0·1627	0·2210
14·880	64	23 14 36	4 23	0·1446	0·2188
19·008	62	23 19 40	4 48	0·1261	0·2156
22·961	60	23 24 55	5 15	0·1070	0·2113
30·357	56	23 35 46	6 11	0·0676	0·2003

UNION OBSERVATORY, JOHANNESBURG. — Circular No. 39 of the Union Observatory includes a series of micrometric measures of Eros made between May 15 and May 28 of the present year, and a discussion of the advantages of ruling star photographs with lines of right ascension and declination, as compared with the rectangular rulings of the Carte du Ciel. Another excellent example of the photographic maps now being issued from this observatory is included with the circular, and it is shown that from these the places of stars can be obtained with an accuracy which will suffice for most purposes. A further list of nearly 200 proper motions found and measured with the blink-microscope is also given; about fifty of them exceed 20″ per century, and many of the displacements are towards the solar antapex. Many of the centennial proper motions deduced, and believed to be trustworthy, are under 10″, and one is only 3·2″.

NEW ZEALAND ASTRONOMICAL TABLES.—For general information, the Government Astronomer of New Zealand has issued a series of astronomical tables calculated for the meridian of the Hector Observatory (*New Zealand Gazette*, No. 141). They give the sun's apparent right ascension and declination, and the Greenwich mean time at apparent noon, as interpolated from the Nautical Almanac, together with the Greenwich date. With the aid of auxiliary tables previously published, the G.M.T. at apparent noon may readily be deduced for any other meridian in New Zealand, and also the approximate times of sunrise and sunset.

DEVELOPMENT AND USES OF THE STATIC ELECTRICAL MACHINE.

A VERY great advance was made in the earliest form of electricity generator by the late James Wimshurst in the year 1882. At that time several forms of the Holtz and Voss machines were in use, but their behaviour was most erratic, the slightest moisture in the atmosphere rendered them useless, and under most favourable conditions the output of electricity was small indeed.

Wimshurst succeeded in producing a machine that would "excite" with certainty under almost any atmospheric condition, and by combining a number of plates was able greatly to increase the output. Since then many manufacturers of electrical apparatus have attempted to improve upon it and to convert it into a practical and mechanically efficient generator of electricity. The Medical Supply Association has now placed upon the market what appears to be a thoroughly trustworthy and strong British-made machine that will give, at a moment's notice, a continuous and powerful static discharge.

The mechanical construction of the machine is simple and very sound. Special attention has been devoted to the plates, which are of vulcanite. By an ingenious method of construction each plate is formed of three sheets of different qualities; this entirely stops any tendency to warp, and enables the outer surface to be formed of a very good quality brittle vulcanite that in itself would not bear the high speed of rotation. The whole machine is built upon a cast-iron table, and is run by an attached motor or by any other convenient means; it is not covered in any way, as the perfection of construction is such that electricity is generated immediately on rotating the plates even in the dampest weather.

The uses of the machine are very numerous. It has been employed with success in agricultural experiments, where greatly increased plant growth under the influence of the static discharge has been recorded. In electro-therapy its value is fully recognised, and the static discharge is now in constant use in many hospitals. For the production of X-rays the machine has advantages over the induction coil, the current being unidirectional and continuous. For fluoroscopy or screen work this is a great gain, as the image is bright and absolutely free from flicker. Except where very short exposures are necessary, as in the case of instantaneous radiography, it will do the work as well as, or even better than, a coil. The twelve-plate machine is run at 900 revolutions per minute, and gives a good discharge between balls 8 to 10 in. apart; currents from ¾ to 1 milliampere can be passed through a suitable tube.

One great convenience of the machine is the complete absence of complicated resistance coils, meters, and other accessories; no electrical knowledge is demanded in its use; it is always ready, and it only needs rotating to produce the current. The cost of running with an electro-motor works out at ⅛d. per hour.

The machine can be seen at the rooms of the Medical Supply Association, 228 Gray's Inn Road, London, W.C.1.

THE ASIATIC SOCIETY OF BENGAL.

THE publications of the Asiatic Society of Bengal are fully abreast of those of the learned societies of the European world. To the Indian they are reminiscent of a glorious past, and give a forecast of the Asiatic world that is advancing by leaps and bounds into the domains of commerce, industry, art, and science. They breathe to-day not only of the society's great founder, Sir William Jones, but of a new Asiatic life. In the founder's first presidential address (delivered in Calcutta in 1784) we read: "Whether you will enrol, as members, any number of learned natives, you will hereafter decide." It is a somewhat curious paradox on these words that the present membership is not only very largely "learned natives," but that many of the recent articles of conspicuous merit are from the pens of Asiatic writers. Indians are, in fact, pressing forward in every department of thought and research, and are practically clamouring to write the too long neglected history of their country. There are eighty-seven important articles in the Journals (placed in our hands), and of these forty-seven are written by native gentlemen. In this connection it may be mentioned that the "Centenary Review" of the society (published in 1885) was written in three separate chapters, the authors of which were two native gentlemen and a German. But to revert to the founder, Sir William was no lover of systematic natural history. He lived in Sanskrit lore, and could see no merit in, or necessity for, systematic studies. The direction was thereby given for the future life of the society, and to-day were one to seek out themes of adverse criticism the most obvious would be that the volumes on our table denote a disproportionate treatment of zoology and botany as compared with philology, ethnography, mythology, anthropology, numismatology, archæology, and history, each no doubt important, but not more so than either zoology or botany, to the new life of India.

The first botanical paper published by the society appeared in 1785, and was on the *mahua* tree (*Bassia latifolia*). We are there not only given a botanical description and an instructive plate, but a full account of the economic uses of that most valuable tree, which to-day is of exceptional interest as a source of food, oil, and spirits. In vols. iii., iv., and v. of the Memoirs, now before us, there is not a single botanical article. The corresponding Journals contain remarkably few botanical papers, and those that are given are short and deal as a rule with structural adaptations to environment or to fertilisation. "Grafting the Mango Inflorescence," by Dr. W. Burns and Mr. H. Prayag, is, however, interesting and suggestive. To what may be called the general rule there are two exceptions—"The Materials for a Flora of the Malayan Peninsula" and a "Synopsis of the Dioscoreas of the Old World." The former, started by the late Sir George King, has now run into its fourth volume, and is being ably continued by Mr. J. Sykes Gamble, late of the Indian Forest Department. The title of that great work is far too humble, since it is literally an exhaustive flora of the Malayan Peninsula, and it very possibly has suffered considerably by its production intermittently as an appendage to the Journal of the Asiatic Society of Bengal. The second paper is by Sir David Prain and Mr. I. H. Burkill, and deals with an exceedingly difficult genus of plants, many of the species of which are of considerable economic value.

Zoology has in India always taken a more favoured position, a circumstance possibly due to the closer association of the Indian Museum, than the distant Botanic Gardens, with the home of the Asiatic Society. Dr. Annandale has communicated numerous papers (some written for him by experts) on the "Biology of the Lake of Tiberias," as also "The Distribution and Origin of the Fauna of the Jordan System." Lt.-Col. J. Manners-Smith has furnished useful information regarding the Shous, or big-horned deer of Tibet. Mr. F. C. Gravely has contributed a paper on the "Evolution and Distribution of the Indian Spiders belonging to the Sub-family Aviculariinæ." Mr. J. Hornell gives an excellent account of the "Pearl Fishery in Palk Bay." This would appear to be a new bed hitherto unsuspected, which, but for the war, would have given greater results than have been attained. Mr. Hornell records it as his opinion that, in the future, cultural operations directed to the inducement of pearls in a comparatively limited number of oysters, kept in captivity, must supersede production in natural beds. Capt. R. B. Seymour Sewell, surgeon-naturalist of the *Investigator*, contributes a valuable report on the results of his biological investigations. Dr N. Annandale, Mr. J. Coggin Brown, and Mr. F. H. Gravely have furnished the results of their joint investigations of "The Limestone Caves of Burma and the Malay." Mr. Gravely further contributes a paper on "The Evolution and Distribution of certain Indo-Australian Passlid Coleoptera."

Mr. R. D. Banerji, of the Indian Museum, under the title of "The Pālas of Bengal," gives a history of Bengal and Bihar from A.D. 800 to 1200. Many obscure points regarding the Pāla kings have, through Mr. Banerji's researches, been cleared up, while the photographs he furnishes of inscriptions and colophons should facilitate verification. In another paper Mr. Banerji analyses the evidence and conclusions of the four inscriptions regarding the "Laksmanasena Era"; and again discusses the "Edilpur Grant of Kesavasena," originally translated by Prinsep in 1838; and in still a further paper deals with the "Four Forged Grants from Faridpur." Rai Monmohan Chakravarti Bahadur gives a learned and exhaustive "Contribution to the History of Smrti in Bengal and Mithilā." To the historical student the works translated by Mr. Chakravarti are of great importance. They furnish a mass of information bearing on the social and religious life of the people of Bengal in former times. In another contribution Mr. Chakravarti deals with "The History of Mithilā," during the pre-Mughal period, and this versatile writer next discusses the geography of Orissa in the sixteenth century, and in still another paper exhibits "The Genuineness of the Eighth Canto of the Poem of Kumara-Sambhavam," by Kalidasa.

Mr. Nundolal Dey furnishes an account of the ancient Anga, or district, of Bhagalpur, one of the most ancient countries of northern India.

Dr. L. P. Tessitori gives "A Progress Report on the Preliminary Work done during the Year 1915 in connection with the Proposed Bardic and Historical Survey of Rayputanam." In the Memoirs the Rev. H. Hosten, S.J., narrates his discovery in Calcutta of the original MS. of "Father A. Monserrate's 'Mongolicæ Legationis Commentarius'"—in other words, Monserrate's account of the first Jesuit mission to the Emperor Akbar, in 1580–83. After an interesting discussion of the history and movement of the MS., Father Hosten reproduces the Latin text and gives, in an appendix, useful explanatory notes. He further contributes to the Journals, among others, three papers:—(1) "The Twelve Bhuiyas or Landlords of Bengal"; (2) "Fr. Jerome Xavier's Persian 'Lives of the Apostles'"; and (3) "Notes on Father Monserrate's 'Mongolicæ Legationis Commentarius.'" There are numerous papers on anthropology and ethnology; one of special interest deals with the Abors and

Galongs. This is written by Capt. Sir George Duff-Sutherland-Dunbar and is beautifully illustrated.

To mention by name even all the more interesting papers given in these Memoirs and Journals would occupy many pages; as already suggested, they give abundant evidence of a new life in our Eastern Empire. The suggestion might be offered, however, that the division of these publications into at least three sections, each with its own separate volume, would be both an economy and a convenience.

NEW FRENCH MAGNETIC CHARTS.[1]

IN France terrestrial magnetism is included in meteorology, and the actual survey upon which the present work is largely dependent was made by M. Moureaux, director of Parc St. Maur Observatory, then the central magnetic station for France. Prof. Angot, who is director of the French meteorological service, was responsible for the last magnetic charts relating to the epoch January 1, 1901. Whether fresh charts will continue to be published every ten years appears as yet to be undecided. Two methods were considered of obtaining the secular change data, necessary to derive results for January 1, 1911, from those for 1901. The first consisted in taking fresh field observations in a sufficient number of places, and some observations having this end in view were taken by M. Eblé in 1912 and 1913. These have served to some extent as a control, but the second method was that actually depended on. It consists in utilising the secular change data published by observatories in France and adjacent countries, including Potsdam, De Bilt, Valencia, Greenwich, Kew, Falmouth, Val Joyeux, Munich, Pola, Naples, Coimbra, and San Fernando. The ten-year secular changes at these stations were plotted in a map, and curves of equal secular change drawn, from which were deduced the secular changes appropriate to each station. The method is obviously more suitable for France than for the British Isles. But even in the case of France, in the absence of positive knowledge that secular change is unaffected by local disturbance, it is doubtful whether it will be universally admitted that the method is altogether satisfactory for the deduction of charts showing the local anomalies. It is obviously simpler, however, than the carrying out of observations at a large number of repeat stations.

The values deduced for the epoch January 1, 1911, for declination, inclination, horizontal and vertical force, north and west components, and total force are given for from 500 to 600 stations, arranged alphabetically under the several departments. The declination, inclination, horizontal force, and vertical force data are also embodied in four charts. Omitting a few incomplete or obviously disturbed stations, the remaining 538 were arranged according to geographical position in twenty groups or areas. Taking any one group, the mean of the observed values of, say, declination was assigned to an imaginary station, the geographical co-ordinates of which were the mean of those of the actual stations. In this way values were found, practically free from accidental irregularities, for twenty different points. It was then assumed that these twenty values could be represented by an expression, $a+b\phi+c\lambda+d\phi^2+e\phi\lambda+f\lambda^2$, where $\phi+47^\circ$ and $\lambda+2^\circ$ represent the latitude and easterly longitude of any station. The constants were determined both by least squares and by Cauchy's method, with very satisfactory results, showing that a simple quadratic expression suffices to give normal magnetic values with high accuracy for the whole of France.

Tunis, Algeria, and Morocco are treated by themselves (pp. 86–95). The available data consisted of observations taken by Moureaux at thirty-three stations in 1887, and of recent results obtained by the observers of the Carnegie Institution of Washington. The latter had observed at thirteen of Moureaux's stations, thus obtaining data for secular change which were supplemented by results from the observatories of San Fernando, Coimbra, Tortosa, Naples, and Helwan. A six-constant formula of the type already described seems to fit the observations reasonably well. Prof. Angot would like, however, to have fresh observations throughout North Africa, at a considerably larger number of stations. Declination, inclination, and horizontal force charts, representing normal values for North Africa as given by the interpolation formulæ, appear in the text, but on a reduced scale as compared with that adopted for the French charts, which show the actual anomalies.

C. CHREE.

[1] "Réseau magnétique de la France et de l'Afrique du Nord (Tunisie, Algérie, Maroc) au 1er janvier 1911." By Prof. Alfred Angot. Ann. du Bureau central météorologique de 1911, tome i., pp. 59-95+4 charts.

RAINFALL IN NORWAY DURING 1916.[1]

THE director of the Norwegian Meteorological Institute has, with commendable promptitude, published the twenty-first annual volume of rainfall data, viz. that dealing with last year's returns. The daily rainfall is given *in extenso* for about 200 stations, additional information regarding the nature of the precipitation, whether in the form of rain, snow, or sleet, being afforded by the international symbol affixed to the reading when the downfall was other than rain. A monthly summary shows, for each of 476 stations, the actual precipitation, the maximum daily fall, and date of occurrence, along with the number of days with more than 0·1 mm. and more than 1·0 mm. of rain respectively; the mean depth of snow is also given and the greatest depth recorded. The monthly and annual rainfall expressed as a percentage of the average is shown for sixty-four stations.

No general summary of the results appears, but there is an excellent large-scale map in two sections showing the distribution of the annual rainfall for 1916 by isohyetal lines drawn for each 200 mm. The maximum rainfall, shown by the isohyet of 3000 mm. (118 in.), appears in three small patches close to the coast, between lat. 60° and 61° N., the highest rainfall, 3127 mm. (123 in.), being at Indre Matre (height 15 m.), in lat. 60° N., long. 6° E. The smallest rainfall, about 200 mm. (8 in.), occurs in several areas of no great extent north of the Arctic Circle, the most extensive being an oval patch about eighty miles long and fifteen miles broad, situated due south of Hammerfest. The isohyets in some districts near the coast are very crowded, especially in areas contiguous to the wettest spots. where the rainfall in rather less than forty miles falls off from about 120 in. to 32 in.

As compared with the average, the rainfall of 1916 on the mean of sixty-four stations was 5 per cent. in excess, but individual stations varied from 51 per cent. above to 41 per cent. below the average. Rainfall was much above the average at most stations to the south of lat. 63°, but north of Trondhjem (lat. 63·4° N.) there was a pronounced deficit, ranging in general from 15 to 40 per cent. The only marked exceptions were at Gjesvair and Vardo, stations to the north of 70° and far to the east. In no month did the rainfall show a general excess or defect over the whole country, although March and August were dry, and January wet nearly everywhere. In February, June, and October to December there was a pronounced tendency to rainy conditions in the south, while a drought was experienced in the north of the country.

[1] Nedbøriagttagelser i Norge, utgit av Det Norske Meteorologiske Institut. Aargang xxi., 1916.

In September, on the other hand, the opposite distribution prevailed.

From an examination of the detailed summaries it would appear that the greatest daily rainfall, 140 mm. (5·51 in.), occurred on April 1 at Livastøl, a station in lat. 59° N., long. 6° E. Only nine daily falls exceeding 4 in. were reported in the year under notice, and, with one exception, these all occurred in the south. A very useful table is given showing the height above sea-level and geographical co-ordinates of all the stations, which can thus be readily identified on the map.

R. C. M.

PLANT DISEASES IN THE WEST INDIES.

VARIOUS root diseases which cause serious loss in crops of cacao, coffee, limes, and arrowroot in the West Indies have been investigated by Mr. W. Nowell, whose conclusions are published in the West Indian Bulletin (vol. xvi., No. 1). In all cases the roots are attacked by the mycelium of species of Rosellinia, a cosmopolitan genus of fungi which has long been known to include several parasitic species. In most cases the source of infection has proved to be either the forest stumps left to decay when the land was originally cleared, or, in the case of cacao, the stumps of shade trees, such as bread fruit and avocado pear. The fungus establishes itself on the dead stumps as a saprophyte, and from these the mycelium spreads to the healthy roots of the crop. The general conditions which favour the spread of the parasites and the most suitable methods of isolating the infected area and controlling the disease are carefully discussed.

In the West Indian Bulletin (vol. xvi., Nos. 2 and 3) Mr. W. Nowell gives a first report on an investigation of the internal disease of cotton bolls in the West Indies. The young lint is badly stained, and in severe cases more or less completely rotted, by the action of bacteria or of certain specific fungi, which are described in the first of the two papers. Four distinct species of fungi have been isolated and studied in culture. They appear to be all closely related, and are probably to be referred to the genus Nematospora. Further investigation is needed, however, to determine the systematic position of the genus. The results of the experiments recorded in the second bulletin show that infection results from the attack of certain cotton-stainers, bugs. *Nezara viridula* and *Dysdercus spp.*, which puncture the ovary walls in order to reach the seeds. The damage caused by the bugs includes the death of a certain proportion of the seeds, and possibly a localised discoloration of lint in young bolls; they are, however, the agents by which the fungi and bacteria are introduced into the ovary, and there produce the characteristic boll disease.

MINERAL NOMENCLATURE AND COLOUR.

A PAPER by Mr. Edgar T. Wherry on "The Nomenclature and Classification of the Native Element Minerals" (Journ. Washington Acad. Sci., vol. vii., p. 447, August, 1917) is remarkable for its advocacy of the use of adjectival prefixes for varieties, rather than special or compound names, which involve, as may be remarked, an additional tax upon the memory. This attitude is so very rare among scientific men that the attention of all naturalists may be directed to it. Mr. Wherry thus gives us "mercuriferous silver" for one end of the amalgam series and "argentiferous mercury" for the other, while the former name swallows up arquerite, bordosite, and kongsbergite. "Rhodiferous gold" replaces rhodite and "ferriferous nickel" awaruite, josephinite, occtibehite, and souesite. The realisation that time is very often lost and not gained by the use of technical names instead of descriptive word-groupings will make mineralogists regard Mr. Wherry's work with favour. His paper, however, is much more than a revision of nomenclature, since the element minerals are critically reviewed, with a number of valuable references to recent work.

Messrs. T. L. Watson and R. E. Beard have made a careful study of "The Colour of Amethyst, Rose, and Blue Varieties of Quartz" (Proc. U.S. Nat. Museum, vol. liii., p. 553, 1917), and they conclude that amethyst is coloured by manganese, probably distributed as submicroscopic colloidal particles of an oxide; that the colouring matter in rose quartz is organic; and that the blueness of quartz, as seen in many igneous rocks, is due to the behaviour of light on minute hair-like inclusions of rutile, as previous writers have suggested. No explanation is proposed for the absence of a purple colour in certain examples of rose quartz which show on analysis quantities of manganese in excess of those in ordinary amethyst; the point seems worth raising, since the authors reject the idea that the colour in amethyst depends on the state of oxidation.

A VILLAGE COMMUNITY IN PAPUA.

IN the thirty-ninth volume of the Transactions of the Royal Society of South Australia Dr. B. Malinowski, Robert Mond travelling student in the University of London, gives a valuable account of the people living on the seaboard of south-eastern Papua between Cape Rodney and Orangerie Bay.[1]

The most important native village is Mailu, on a small island near the coast, the inhabitants of which take a prominent place in the trade of southern Papua, and in certain industries, such as pottery and canoe-building, are more advanced than the mainland people. Dr. Malinowski's descriptions refer principally to Mailu itself but the people of the mainland district, who call themselves Magi, are occasionally noticed.

Following Dr. Seligman in his account of the "Melanesians of British New Guinea," Dr. Malinowski regards the Mailu as the most eastern branch of the western Papuo-Melanesian population, the Bonabona division of the southern Massim being in contact with their eastern border. The sociology and culture of the Mailu are of the same type as those of the Koita, so fully described by Seligman. Like the Koita, too, they speak a non-Melanesian language, though this is not explicitly stated by Dr. Malinowski, whose information was obtained by means of the Motu language, which is understood by most Mailu men.

The unit of social life is the village community. The village is a compact group of houses regularly built on land. The houses, on piles, face each other on each side of the village street, with their backs to the sea and the gardens. The men's club-houses, or *dubus*, have now almost died out. The community was the joint owner of the land and fishing rights, and within certain limits of hunting rights. In legal arrangements, institutions, and warfare the community acted together. It is divided into clans, and the wife comes from outside and moves to the home of her husband. Children belong to their father's clan.

Dr. Malinowski gives details of the household, with diagrams of the building. A genealogical census of Mailu village was made to obtain the kinship system and names. Personal names of elders were found to

1 "The Natives of Mailu: Preliminary Results of the Robert Mond Research Work in British New Guinea." By Dr. B. Malinowski, Cracow, Robert Mond Travelling Student in the University of London. Transactions and Proceedings of the Royal Society of South Australia, vol. xxxix., Adelaide, December, 1915, pp. 494–706, plates xxvi–xliii.

be taboo. The daily life of the natives is described, first as to the individual (toilet, dress, ornaments, and food), and then with regard to the community (seasonal occupations, courtship and marriage, children and their play, public law and the restrictions of taboo, warfare, economics). The sections on agriculture and hunting are illustrated by plans and diagrams. Fishing, trade, and industries are similarly illustrated.

In magic and religion a very prominent feature is belief in the *Bara'u*, a living man who can make himself invisible and prowls about in the night working evil magic. Some suppose him to be invisible in front, though he can be seen from behind. He can be heard, travels like the wind, and injures his victim in various ways. The ghosts, or *Bo'i*, who dwell in the preserved skulls of the dead, are not so feared. Their spirits go to a distant place.

The author deals fully with maleficent and beneficent magic and with feasting and ceremonial, both in joy and sorrow. He concludes with an account of burial customs, art, and knowledge.

Dr. Malinowski's long paper is a fine piece of work, and an extremely valuable and interesting contribution to the ethnography of New Guinea. It is abundantly illustrated by diagrams in the text, by thirty-four pictures from the author's photographs, and by a map. The paper is a credit to the society which has found such ample space for it in its Transactions.

SIDNEY H. RAY.

OIL PROSPECTS IN THE BRITISH ISLES.

MR. W. H. DALTON read a paper upon the above subject before the Institution of Petroleum Technologists on November 20. He deals in the paper with actual liquid petroleum only, and not with the potentialities of distillation from so-called oil shale, from coal, peat, or any other carbonaceous solids. He regards the widespread conception of a store of petroleum of commercial value lying intact within the limits of the British Isles as wholly untenable. Nature seems at all times since the initiation of organic life to have evolved hydrocarbons, in very variable quantity, sometimes for prolonged storage, often for rapid dissipation. In a rapid summary, in geological order, of all recorded appearances of oil or tar within the kingdom, the Carboniferous series receives most attention, chiefly from the extensive mining operations, which have revealed pockets of oil where none is seen at the surface. Those occurring in the Scotch oil shales are presumably due to natural distillation by the heat of intruded igneous rock. Others, in the Yorkshire and associated coalfields, are assigned to the alternations of terrestrial with marine conditions.

It must be borne in mind that the roof of a coal seam *ipso facto* implies a change of conditions, from terrestrial vegetation to subaqueous deposit of sediment, and this was in not a few cases brought about by subsidence, the sea often invading an area previously supporting terrestrial growth. In the Staffordshire coalfield many such marine invasions have been detected, and several in Derbyshire and Nottinghamshire. The coeval deposits of Yorkshire and Lancashire would doubtless furnish similar evidence if fully studied in this respect.

If petroleum is principally due to marine organisms, whether vegetal, animal, or of the neutral character at the bottom of either scale, such invasion furnishes at once a wider area for occupation, and abundance of dead vegetation as nutriment. Consequently, the roof of a coal seam is a watery paradise for the development of oil-making organisms, and if the deposited sands or clays are of suitable character for storage and cover, there is a chance for the formation of oil, but in no case has there been found a store of high commercial value.

Besides abundant exposure at the surface, the British geological series has for centuries been subjected to penetration by mines and borings practically throughout its thickness, and no extensive area has escaped the test of drill or pick.

It is much to be doubted whether in any part of the Secondary rocks or of the subjacent Palæozoic series there exists any deposit of petroleum of a commercial value commensurate with the cost of wild-cat search (for such it must needs be) and subsequent exploitation. Yet the Kelham and Norton instances, in the Millstone Grit and Yoredale beds respectively, demonstrate the possible occurrence of oil in deep-seated portions of series of which the wide areas of outcrop yield no similar indications. In view of our ignorance of the tectonic structure obtaining in these older rocks to the eastward of proved points, the term wild-cat is not too strong; for, although the overlying rocks indicate various tectonic movements—presumably influenced in depth by pre-existing structure—we do not know the degree of that influence, still less the extent to which the older rocks have been brought within reach of denuding agencies to form the floor on which rest the newer rocks; an anticline in the Secondaries may be "posthumously" along one of older date—it may be oblique or directly transverse to flexures that would control the accumulation of Palæozoic oil, if such exists.

It is demonstrated, then, that in the British Isles—as in other parts of the world—oil-forming conditions have frequently recurred, but to a very limited extent; and although conditions favouring its accumulation, and tectonic structures capable of conserving it from escape, are also of frequent occurrence, the conjunction of the latter essentials with original formation has generally failed. Our reservoir rocks are full of water, demonstrating the absence of liquid hydrocarbons. The curves of our anticlines and synclines serve to enhance the beauty of our landscapes, and their formation has, under favourable conditions, resulted in ore-bearing veins, but to reduce that ore, as generally for heat, illumination, and motive-power, we must continue to depend upon solid minerals of native source, and fluid combustibles imported from abroad.

The feeble and short-lived flows which our rocks exhibit necessarily conform to the same hydrostatic laws as the vast bulks of other regions, but whether from defect of original formation, of space accessible for accumulation, or of adequate seal from escape, the total result is, from a practical commercial point of view, valueless, except possibly in the one or two cases mentioned above. To geologists, negative evidence in respect of petroleum would be accompanied by so much of interest and value in other directions that their trivial share in the cost would be gladly borne, but owners who looked for royalties would be less complacent under their disappointment. Hope is more easily excited than regrets are consoled. It is scarcely necessary to say that the drill and pump constitute the final court of appeal, but the charge of hoarding petroleum is not one at all likely to be substantiated.

EXPERIMENTS ON TRIBO-ELECTRICITY.

IT is strange that tribo-electricity—that is, the subject which deals with the production of charges by rubbing together unlike materials—has been so greatly neglected by experimentalists during the last century. A dozen branches of electricity have, during

that period, been developed to the dignity of voluminous quantitative sciences, whilst this section of the subject, which is of great antiquity, can be dealt with on a page or two of a text-book, and consists of incoherent qualitative facts.

A recent paper by Dr. P. E. Shaw (Proc. Roy. Soc., November, 1917) discloses interesting results, and indicates that this neglected field of research is being developed. Throughout the experiments described the conditions of the surfaces used were varied systematically—by rise of temperature before and during friction; by treatment when flexed; and by previously grinding or polishing, and so on. It is well known that there are condensed films on the surfaces of many solid materials. Little is understood as to the nature or depth of these adsorbed layers, but they have proved a veritable stumbling-block to the investigator of certain phenomena—*e.g.* surface-tension and photo-electricity. But these films have little influence on tribo-electric effects, for here there is always a rough impact of solid on solid, the films are penetrated, and the true solid surfaces bear on one another.

The tribo-electric series consists of thirty-six places in order from the extreme + at top to the extreme − at bottom. The outstanding feature of the present results is the readiness with which a solid changes its place in the series when its surface condition is changed by heat, abrasion, flexure, and the like. Thus ordinary soda-glass drops from place 5 to place 21 when made matt, and to place 26 when its temperature has been raised to 245° C. Mica, which normally occupies place 6, drops to place 18 when matt, and to place 26 when heated to 270°. On the other hand, ebonite rises from place 28 to place 27 when matt, and to place 21 when heated to 100°. The remarkable character of these changes is that they are not erratic, but follow a simple law, as follows: All materials in the series above place 14 fall when rendered matt or after heating; but all materials in the series below 14 have the contrary tendency, and rise when heated or made matt. Thus the tendency is for the two ends of the series to come together as a result of these changes of condition. The temperature at which the change by heat occurs is quite definite for each material, and has been found for some sixteen metals and non-metals. It ranges from 70° C. to 300° C.

Dr. Shaw considers that this diametrically opposite behaviour in the + and − groups of the series indicates the existence of two kinds of atom or atomic group, one kind for each group, the difference between the two kinds being fundamental. But whatever form the theory of these effects may take, these new facts can scarcely fail to be of great importance. The research provides an explanation of the well-known readiness with which materials change their tribo-electric character. It should now be possible to avoid, in great measure, the confusion and irregularity which have hitherto characterised the subject.

THE RELATION BETWEEN CHEMICAL CONSTITUTION AND PHYSIOLOGICAL ACTION.[1]

THE relation between chemical constitution and physiological action occupies a definite and important place in the study of drugs. Chemical investigation of a drug begins with the attempt to isolate the principle to which its activity is due. Then follow the determination of its constitution and the synthesis of a number of substances related to the parent compound, and comparison of their physiological action.

The wideness of the term "physiological action," covering as it does any action on the living organism, renders its discussion difficult. It is impossible, for instance, to compare the bactericidal action of phenol with the hypnotic effect of diethylbarbituric acid, or with the anæsthetic action of cocaine, for the same superficial signs of physiological action may be due to widely different causes. Examples of physiological action are not wanting. Compounds of similar constitution generally possess a characteristic group-smell, whilst each member may have a specific odour. Sense of taste also provides an occasional means of discrimination not only between side-chains of different length, but also in certain cases between stereoisomerides.

Stereochemical influences often exercise profound effects, particularly on nerve-endings. Thus *l*-hyoscyamine has about a hundred times the mydriatic action of *d*-hyoscyamine, and *l*-adrenine many times the pressor effect of the dextro-compound. Asymmetry of a nitrogen atom may also condition a difference, as in the case of the *α*- and *β*-methochlorides of *l*-canadine. The cause of this variation still remains in doubt.

The influence of physical properties, such as solubility in different media, may be of importance, and it has been shown that for a particular series of aliphatic compounds their narcotic effect on tadpoles was proportional to the partition-coefficients of their solubilities in oil and water.

As an indication of the effect of chemical properties, it has been shown that whilst certain basic dyes stain the grey nerve substance, their sulphonic acids do not. This difference suggested that bases, liberated in the blood-stream by alkalis, are extracted by the nerve substance, whilst their sulphonic acids remain in solution as alkali salts.

In the case of alkaloids it is a general rule that the introduction of a free carboxyl group profoundly modifies the physiological action. Benzoyl ecgonine, of which cocaine is the methyl ester, has no local anæsthetic action; whilst quitenine, obtained from quinine by oxidation of the vinyl group, is non-toxic. Formation of quaternary salts has also a considerable effect. For instance, papaverine has a strychnine-like action which is missing in its methochloride, and reappears in its reduction product laudanosine.

In the many cases in which members of a group of compounds of similar constitution resemble one another in physiological action it is of interest to observe the effect of slight chemical alterations. The following four pieces of work were then outlined:—(1) *Tropeines* (acyl derivatives of the amino-alcohol tropine); (2) *aminoalkyl esters* (formed by the esterification of an *acid* with an *alcohol* containing an *amino*-group); (3) *adrenine and the amines* (adrenine is the active principle of the suprarenal gland); (4) *protozoacidal drugs*. The results of experiments that have been made on the relative toxicity to infusoria of a number of cinchona derivatives, with a view to their employment in the treatment in malaria, indicate that ethylhydrocupreine was the most active, but they do not admit of any certain conclusions as to the relation between their chemical constitution and protozoacidal action.

Experiments have also been made on the relative toxicity of the ipecacuanha alkaloids to amœbæ, and they indicate that the full amœbacidal action characteristic of emetine is exhibited only when the nucleus is intact.

[1] Summary of a lecture delivered before the Chemical Society on December 6 by Dr. F. L. Pyman.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The University has gratefully accepted an offer received from Mrs. King, of Worthing, to give 1000*l*. 5 per cent. War Stock for the establishment of a scholarship for research work on fevers, in memory of her daughter, Nita King, a member of a Voluntary Aid Detachment, who died of cerebro-spinal fever in France.

LONDON.—Prof. Bernard Pares, professor of Russian history, language, and literature in the University of Liverpool, has been appointed the first incumbent of the chair of Russian which has been established by endowment from the London County Council, and will be tenable at King's College.

The degree of D.Sc. (Economics) has been conferred on Mr. A. D. Smith, an internal student, of the London School of Economics, for a thesis entitled "The Development of Rates of Postage."

DR. ARNOLD EILOART has been appointed assistant lecturer in chemistry, and Mr. J. T. Westwood assistant lecturer in mechanical engineering, at the Technical College, Huddersfield.

MISS E. C. TALBOT, of Margam, has presented to the council of University College, Cardiff, a benefaction amounting to about 30,000*l*., which will produce a salary of 1500*l*. per annum for the purposes of a chair in preventive medicine. The first occupant of the chair is to be nominated for election by the council by an expert board, o which Sir Wm. Osler is to be chairman.

PARTICULARS of a novel form of technical instruction have reached us from America. A winter school for the training of librarians is to be held at the Riverside Public Library, Riverside, California, from January 7 to March 2 of next year, and the services of numerous experts in library administration have been secured as lecturers and demonstrators. Among the subjects of lectures included in the attractive programme offered to intending students are:—The library as a museum, high-school libraries, library mechanics and handicraft, cataloguing and classification, office filing and indexing, and binding and repair work.

THERE is evidence that the need for improved technical education in France is engaging the attention of the authorities. The question was first raised a year ago by a paper by M Léon Guillet in the *Bulletin* of the French Society of Civil Engineers for October-November, 1916. The meeting at which the paper was read was presided over by the Minister of Commerce and Industry, and out of the discussion which arose a committee was formed for the purpose of submitting recommendations to the Minister mentioned. Discussion was invited from persons not members of the society, and the results are published in the *Bulletin* of the society, January-April, 1917, and the *Revue de Métallurgie*, May-June, 1917. A summary of the committee's recommendations also appears in the September-October number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*.

THE Committee on the Neglect of Science has published an article by Sir Ray Lankester on the new scheme of examination for Class I. of the Civil Service. This is of considerable interest to those concerned with the position to be occupied by science in secondary-school and university education in the future. An admirable summary of the report of the Government Committee under the chairmanship of Mr. Stanley Leathes is embodied in this statement, and Sir Ray Lankester frankly admits that the new proposals are a great advance in the direction desired by the Neglect of Science Committee. The Government Committee, in its report, has, however, contented itself with attempting to secure equality of opportunity to all branches of learning, and considers that the schools and universities should do the rest. Whether the theoretical advance will prove of practical value remains to be seen, for the older universities and great public schools are, without exception, dominated by the "classics." In the concluding sentence of Sir Ray Lankester's article the position is summed up as follows:—"Mr. Stanley Leathes's Committee, instead of rescuing education from the professional vested interests of the classical schoolmasters, hands back the victim, after many professions of good will, to the tender mercies of those who are banded together to starve, torture, and discredit her, and remorselessly to maintain the domination and the pecuniary allurements of the 'classical system.'"

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 13.—Sir J. J. Thomson, president, in the chair.—Prof. B. **Moore**: The formation of nitrites from nitrates in aqueous solution by the action of sunlight and the assimilation of the nitrites by green leaves in sunlight. Dilute solutions of nitrates exposed either to sunlight or to a source of light rich in light-energy of short wave-length (such as light from mercury vapour arc enclosed in silica) undergo conversion of nitrate into nitrite. There is an uptake of chemical energy in this reaction transformed from light-energy, as in the formation of organic carbon compounds in foliage leaves; it is to be added to the relatively small number of endothermic reactions induced by light. When green leaves are immersed in nitrate solution comparatively little nitrite accumulates, indicating that nitrites are rapidly absorbed by the green leaf. Nitrates taken up by plants from soil would, in presence of sunlight, be changed to nitrites, which are much more reactive than nitrates. This indicates that the early stages of synthesis of nitrogenous compounds are carried out in the green leaf and aided by sunlight. Rain-water collected for a considerable time contains no nitrites, all having been oxidised to nitrates, but if exposed to bright sunlight or ultra-violet light for a few hours a strong reaction for nitrites is always obtained. There is no hydrogen peroxide or ozone in air at surface level. The fresh odour in open air, commonly referred to as "ozone," is probably nitrogen trioxide, which at high dilutions has the odour of ozone. The oxides of nitrogen are probably formed by the action of sunlight, rich in ultra-violet rays, in upper regions of the atmosphere upon air and aqueous vapour.—J. R. **Moir**: The transition from rostro-carinate flint implements to the tongued-shaped implements of river-terrace gravels. Seven flint implements, exhibiting a beak-like profile, have been found, associated with early palæoliths, in certain ancient valley gravels. The implements described exhibit certain characteristics of form only before seen in the rostro-carinates discovered beneath the Pliocene Red Crag and in other pre-Palæolithic deposits in East Anglia. They show also by the nature of their flaking and provenance that they are of early Palæolithic age. The dual character of these specimens is very marked and points to the conclusion that the knowledge of the manner in which to make a palæolith was acquired by long experience in producing rostro-carinates. This view finds support in the experiments in flint-flaking which have been carried out. The specimens have been recovered from a wide area in southern England, and it seems reasonable to regard them as presenting transitional types linking the rostro-carinates with the earliest palæoliths.

Physical Society, November 23.—Mr. W. R. Cooper, vice-president, in the chair.—Prof. J. W. **Nicholson**: Some problems of stability of atoms and molecules. The paper is mainly concerned with the possible existence and stability of atoms, and of molecules formed after the manner suggested by Stark, the link between the atoms in a molecule being provided by a stationary electron on the molecular axis. Atoms on the Rutherford model, though dynamically unstable, are stable for the simple vibrations ordinarily excited; but it is shown in the paper that atoms with such a stationary electron have a much more limited degree of stability. Moreover, they cannot exist even in an undisturbed state unless they are endowed with a negative charge, for no steady motion is possible, and this conclusion extends even to atoms regulated according to a dynamics such as that of Bohr. Stark's conclusions do not, therefore, survive a quantitative treatment, and molecules cannot be formed in the manner he supposes. The paper also discusses the more symmetrical problem, in which there are two such stationary electrons in an undisturbed atom, and it is shown that systems with a transitory existence, which are known by their spectra to occur in the solar corona, are apparently unaccompanied by the still more transitory systems which would be formed by the attachment of an electron after the manner of Stark. This is a further argument against the possibility that two atoms in a molecule can be linked by a single electron, or by two electrons, which attract both atoms.—T. H. **Blakesley**: Uses of certain methods of classification in optics. This consisted of an account of the additions which, in the course of the intervening years, the author had been enabled to make in the general diagram of optical properties, first communicated by him to the Physical Society in the year 1903 (Proceedings, vol. xviii., p. 591).

Geological Society, December 5.—Dr. Alfred Harker, president, in the chair.—E. **Heron-Allen** and J. E. **Barnard**: Application of X-rays to the determination of the interior structure of microscopic fossils, particularly with reference to the dimorphism of the Nummulites. Mr. Heron-Allen said that in the year 1826 d'Orbigny published among the *nomina nuda* that compose his "Tableau Méthodique de la Classe Céphalopodes" the name *Rotalia dubia*. G. Berthelin was the first investigator to make use of the "Planches inédites" which had been partly completed by d'Orbigny for the illustration of his unpublished work upon the Foraminifera. Berthelin made for his own use careful tracings of 246 of A. d'Orbigny's unfinished outline-sketches; among them was the sketch of *R. dubia*. On the death of Berthelin the tracings passed into the possession of Prof. Carlo Fornasini, of Bologna, who reproduced them all between the years 1898 and 1908. Fornasini's opinion was that the organism depicted by d'Orbigny was probably referable to the Ostracoda. Messrs. A. Earland and E. Heron-Allen, while examining the material brought by Dr. J. J. Simpson from the Kerimba Archipelago in 1915, discovered undoubted Foraminifera of an unknown type, which resembled Berthelin's tracing. Prof. Boule sent the d'Orbigny type-specimen to London, and the Rhizopodal nature of *R. dubia* was established. It is not a Rotalia, and it must await determination until more specimens are obtained. It has been named provisionally *Pegidia papillata*. Mr. Barnard experimented with the object of ascertaining the interior structure of the shell by means of the X-rays. A skiagraph of the dense test of *Biloculina bulloides*, d'Orb., shows the arrangement of the earlier chambers as clearly as it is indicated in Schlumberger's sections. The application of X-rays to the dense imperforate shells, *Cornuspira foliacea* (Philippi), produced skiagraphs showing the dimorphism of the shells. The skiagraph of *Astrorhiza arenaria*, Norman, shows the internal cavities that contained the protoplasmic body. Two arenaceous forms, *Botellina labyrinthica*, Brady, and *Jaculella obtusa*, Brady, are distinguished at once by skiagraphs. Mr. Barnard afterwards experimented on still more difficult material. *Operculina complanata*, Defrance, the umbilical portion of which is obscured by secondary shell-substance, furnished a skiagraph that showed curious distortions of the internal septa. The determination of the Nummulites, depending on a knowledge of the internal structure, is facilitated by the application of X-rays.

Optical Society, December 13.—Prof. F. J. Cheshire, president, in the chair.—J. W. **French**: Proposed standard system of optical notation and sign convention. The author pointed out that owing to the non-existence of standards, confusion often arises in the interpretation and use of optical formulæ, due to indefiniteness as to the sign convention employed in their construction. The suggested scheme, which contained about one hundred clauses, dealt with the notation for points, lengths, and angles and the sign convention for lengths and angles. Certain of the quantities were dealt with historically, as, for example, the substitution of the Greek letter "μ" for "n," to represent a refractive index. It was suggested that the more controversial clauses might be discussed by a committee which would issue supplementary lists that would ultimately cover all points, including the definition of terms and other standards.—T. **Smith**: Optical nomenclature and symbolism. The author dealt with the definitions of fundamental quantities, and conventions for positive directions, angles, curvatures, and powers. The necessity for a number of new symbols was shown; a special symbolism was required for oblique pencils. The new symbols proposed for frequently recurring quantities were explained.

Linnean Society, December 13.—Sir David Prain, president, in the chair.—Capt. A. W. **Hill**: Seeds enclosed in a stony endocarp and their germination. In certain genera the seed or seeds are protected by inclusion within a stony endocarp. In such cases it is found that definite provision is made during the development of the fruit for the liberation of the seeds on germination from their stony envelope. In the case of Prunus and similar normally one-seeded fruits splitting apart of the two halves of the endocarp takes place, but in such three- to five-seeded fruits as Canarium, Sclerocarya, Dracontomelon, Saccoglottis, Aubrya, etc., special fenestræ or opercula are provided which are pushed away by the germinating embryo. In Davidia not only are special fenestræ removed, but also portions of the intervening skeletal structure of the endocarp. The remarkable fruit of Pleiogynium encloses several seeds which germinate without any disintegration of the endocarp.—Mrs. Haig **Thomas**: Skins illustrating results obtained in crossing species of pheasants. The cross between silver pheasant (*Gennaeus nycthemerus*) and Swinhoe's pheasant (*G. swinhoei*) gave a remarkable series of segregating forms in the F_2 generation. Amongst these were birds scarcely distinguishable from *swinhoei*. The F_1 form was a combination very distinct from the parental types; and, judging from the frequency with which some of the new forms occurred in F_2, it was evident that they behaved as dominants and likely that they could have been bred true. The cross *Phasianus versicolor* × *P. formosanus* had been made reciprocally. Crosses involving several pairs showed that there were consistent differences according to the way in which the cross was made.

Royal Meteorological Society, December 1[illegible] H. G. Lyons, president, in the chair.—P. Bo[illegible] computation of wind velocity from pilot balloon observations. In this problem the required wind velocities occur as the bases of a succession of triangles in which two sides, *a*, *b*, and the included angle C are obtained by simple calculations from theodolite observations. To solve such triangles *directly* by the ordinary slide-rule method, the two numbers *a*, *b* on the logarithmic scale must be brought into coincidence on the logarithmic sine scale with two angles differing by the magnitude of the angle C. When this has been done the other elements of the triangle can be read off directly. The paper suggests a means of reducing the labour of setting the scales. A prepared chart of logarithmic sine curves is used, which in effect takes the place of the logarithmic sine scale of the slide rule. The other scales are rearranged with the view of reducing the arithmetical work involved in the complete solution of the problem.—E. G. **Bilham**: The use of monthly mean values in climatological analysis. The objects of the paper are:—(1) To determine to what extent computations based on calendar monthly mean values are vitiated by the fact that the latter are of unequal length; and (2) to provide means of applying numerical corrections on account of errors arising from this cause. The mean month is defined as an exact one-twelfth division of the year, or 30·437 days, and that period is used as the standard to which the results derived from the actual months are reduced. The matter is of special interest in connection with the computation of Fourier coefficients to represent the seasonal variation of a meteorological element such as temperature. Regarding the year as a cycle of 360°, errors arise from the fact that the monthly mean values will in general differ by small amounts from the ordinates of the curve corresponding with 15°, 45°, etc. The corrections to be applied to the original monthly means and to the Fourier amplitudes have been determined. The use of these corrections is suggested as an alternative to the employment of five-day means in cases where special accuracy is required.

CALCUTTA.

Asiatic Society of Bengal, November 7.—Sir Charles **Eliot**: Zoological results of a tour in the Far East. *Mollusca nudibranchiata* (*ascoglossa*). The author describes a new species of Stiliger remarkable in the possession of pointed oral tentacles and tentacular prolongations of the foot. The species was found in pools of brackish water at the edge of the Talé Sap, or inland sea of Singgora, in Peninsular Siam.—S. **Kemp**: Zoological results of a tour in the Far East. Decapoda and Stomatopoda. In the course of his tour in Japan, China, and the Malay Peninsula Dr. Annandale obtained eighty-five species of Decapoda and Stomatopoda. Considered as a whole, the main interest of this large collection lies in the fact that all the species were obtained in fresh or brackish water. Little attention has hitherto been paid to the habitat of Decapoda, and, as a rule, no indication is to be found in the literature as to whether a species inhabits fresh, brackish, or salt water. Dr. Annandale's collection supplies precise information on this point, and shows that a surprisingly large number of forms have been able to establish themselves in water that is fresh or of greatly reduced salinity.—Karm Chand **Mehta**: Some observations and experiments on the rust on *Launea asplenifolia*, D.C. The cause of rust on this plant is *Puccinia butteri*. The author has had diseased plants under his observation for a year. He describes the habit and behaviour of the parasite and host, and discusses some microscopic details of the parasite.

BOOKS RECEIVED.

Creative Psychics: The Art of Regeneration. By F. Henkel. Pp. 81. (Los Angeles: Golden Press.) 25 cents.

A Text-book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. Vol. iv., Aluminium and its Congeners, including the Rare Earth Metals. By H. F. V. Little. Pp. xx+485. (London: C. Griffin and Co., Ltd.) 15*s*. net.

The Cause, Prevention, and Treatment of Cancer and other Diseases. By Lt.-Col. W. H. Hildebrand. Pp. viii+163. (London: Cole and Co.)

James Geikie: The Man and the Geologist. By Dr. M. I. Newbigin and Dr. J. S. Flett. Pp. xi+227. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson.) 7*s*. 6*d*. net.

DIARY OF SOCIETIES.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION, at 3.—Electricity and Electric Currents: Prof. J. A. Fleming.

TUESDAY, JANUARY 1.

ROYAL INSTITUTION, at 3.—The Electric Current as a Heater and Chemist: Prof. J. A. Fleming.

THURSDAY, JANUARY 3.

ROYAL INSTITUTION, at 3.—Electricity as an Illuminator and Doctor Prof. J. A. Fleming.

CHILD STUDY ASSOCIATION, at 5.30.—*Discussion*: The Education of the Clever Child: Openers: G. F. Daniell and Miss M. Berryman.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION, at 3.—E[illegible] Dynamos, Motors, Transformers, and Railways: Prof. J. A. Fleming.

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THURSDAY, JANUARY 3, 1918.

ELECTRICAL ENGINEERING.

(1) *A Treatise on the Elements of Electrical Engineering.* A Text-book for Colleges and Technical Schools. By William S. Franklin. Vol. i., *Direct- and Alternating-current Machines and Systems.* Pp. x+465. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 24*s.* net.

(2) *Continuous-current Motors and Control Apparatus.* A Practical Book for all Classes of Technical Reader. By W. Perren Maycock. Pp. xvi+331. (London: Whittaker and Co., 1917.) Price 6*s.* net.

(3) *Power Wiring Diagrams.* A Handbook of Connection Diagrams of Control and Protective Systems for Industrial Plants. By A. T. Dover. Pp. xv+208. (London: Whittaker and Co., 1917.) Price 6*s.* net.

(1) IT is usual for writers of books on electrical engineering to confine themselves to the theory either of direct-current or of alternating-current practice. In an elementary treatise, however, it is best to include both, and this the author has done. A most satisfactory feature is the introduction of the concepts of the modern theory of electrons, and this greatly stimulates the interest of the reader in many of the phenomena and apparatus described. Other excellent features are a free use of the calculus—we were impressed by the pains taken to make the mathematics simple—and the introduction of many easy problems.

After the table of contents, Prof. Franklin gives a list of the national organisations and societies in America relating to engineering, and describes the field in which each society is specially interested. The student is encouraged to obtain further information directly from the secretaries of these societies. In particular, he is advised to write to the Bureau of Standards at Washington to obtain a list of its publications and full information about its activities. This is very properly regarded as an essential part of the education of an American engineer.

In the first few chapters a *résumé* is given of magnetism and electrodynamics. In several places the author has abbreviated his explanations until they are obscure. We read, for example, on p. 73 that when a circuit has a certain inductance "one volt will cause the current in the circuit to increase at the rate of one ampere per second." The uninitiated reader would naturally think that the current goes on continually increasing so long as the volt is applied in the same way as the velocity of a mass of one gram goes on continually increasing when a dyne is applied to it.

The author is hampered by his loyal adherence to the nomenclature list published by the American Institute of Electrical Engineers. For instance, he calls the unit of the flux of magnetic induction the maxwell, and the unit of magnetic induction density the gauss. We deduce also that a gauss is both a gilbert per centimetre and a maxwell per square centimetre. It seems to us that there is a quite unnecessary dragging in of the names of great men of science, especially as the definitions are framed on the assumption that permeability is a simple numeric. Clerk Maxwell would not have admitted this assumption. The American gauss is the unit both of magnetic induction and of magnetic force. Many physicists consider that magnetic induction is caused by magnetic force just as strain is caused by stress. The assumption that cause and effect are measured in the same unit is unjustifiable.

In our opinion the practice of christening units after the names of men of science should be adopted only very sparingly. The watt and the joule are well named, but we deprecate the growing use of the kelvin for the unit in which electrical energy is bought and sold. Those evil-sounding words, also, the abohm, the abampere, and the abfarad, used by Americans are almost libellous to the great men whose memory they are supposed to keep green.

On p. 96 a table of sparking distances is given between spherical electrodes the diameters of which are 0·5, 1, 2, and 5 cm. respectively. The room temperature at which the experiments were made was 18° C., and the reading of the barometer 745 mm. Analysing the figures given, we find that for a given pair of electrodes the spark occurs very approximately when the maximum potential gradient between them attains a certain definite value. Surely the author should have pointed this out. It is a physical fact of great interest and may well prove to be the starting point of new advances in our knowledge. It is at least of practical value to be able to calculate the sparking distances between spheres and the voltages at which the brush discharges begin to appear on them.

The chapter on the electron theory is clearly written, and much knowledge is given in little compass. We are sorry that Peek's formula for the voltage at which the corona appears on cylindrical wires is not given, as it is wonderfully accurate and most useful to power engineers. Descriptions are given of Cottrell's apparatus for precipitating dust and smoke particles from the atmosphere, and of ozonisers for converting oxygen into ozone. But the most interesting devices described are the vacuum-tube current valves the action of which depends on the emission of electrons by hot bodies. These current valves are now much used as receivers and detectors in radiotelegraphy, and also as "amplifiers" either for exciting or for maintaining electric oscillations.

In those parts of the book devoted more particularly to engineering the author describes the latest types of electrical machines, and it is satisfactory to notice how well they illustrate fundamental principles, and how amenable their theory is to elementary mathematical treatment. The series parallel controller, the rotary converter, the frequency transformer, and all the various types

of polyphase motor are cases in point. Some of the proofs given are worthy of high commendation and will be much appreciated by students.

(2) A simple description is given of the various kinds of direct-current motors which are in everyday use, and the elementary theory of their action is explained. The problems which interest the designer are barely mentioned, but the practical methods of testing and the requisite calculations are fully described. The wiring connections are given in far greater detail than in ordinary treatises, and this will be of value to working engineers, enabling them to get a thorough grasp of the requisite connections for the electrical devices which they have to use constantly. Many numerical examples are given. We can recommend this book to the beginner and to all who wish to understand the working of electric starters, controllers, contactors, automatic lifts, etc. The book is well printed, the diagrams are clear, and the machinery and devices described are of the latest types.

(3) The author clearly indicates the scope of his book by describing it as a handbook of connection diagrams of control and protective systems for industrial plants. Considering the limited space at his disposal and the very complicated direct- and alternating-current systems that have to be described, the author has, on the whole, been successful. The reviewer would have liked fuller explanations in places, and some of the diagrams fatigue the eyes. As a book for occasional reference it will prove useful. We notice that in accordance with the practice of many engineers a zigzag line is used to denote an inductive coil. A helical line, however, is more self-explanatory and practically as easy to draw, and we have good hopes that it will soon be universally used. Recommendations to this effect have frequently been made by "symbols" committees in many countries.

A. RUSSELL.

GEODETIC BASE MEASUREMENTS.

La Mesure Rapide des Bases Géodésiques. Par J.-René Benoit et Ch.-Ed. Guillaume. Cinquième édition. Pp. 285. (Paris: Gauthier-Villars et Cie, 1917.)

THE use of invar wires in the measurement of bases in geodetic triangulation, as well as in topographical surveys, has become so well established that a new edition of MM. Benoit and Guillaume's handbook on their employment will be welcomed.

The fifth edition does not for the most part differ greatly from the previous edition, which appeared in 1908, but an additional chapter has been added, in which the results of later experience have been added. The control of the wires, both by fixed marks laid down in a building with which the length of each wire may be compared, and by a short base on which the wires can be used under field conditions, is discussed. The former is in use in England, France, Egypt, India, and elsewhere, while at Potsdam a 240-metre base is used. The permanence of mural control-marks is considered, and the experience of the Bureau at Bréteuil shows that the distance between such points of reference should be verified over a considerable period of time.

The results of base measurements at the Simplon tunnel in 1906, in Uganda in 1907, in Portuguese East Africa, the Argentine, Russia, Mexico, and Rumania are given in some detail, as being operations for which the wires were verified at the Bureau; but these by no means exhaust the list of countries in which the method of measurement by means of wires, initiated by Prof. Jäderin, of Stockholm, in 1890, has been employed. In 1913 a base eight and a half kilometres long was measured near Lyon by the Geographical Service of the Army both with invar wires and with an invar 4-m. bar, in which the mean values obtained by to-and-fro measurements with the bar and those of two wires differed only by 8·3 mm.

The need for comparison between the "bases murales" or the control-marks which now exist in several countries is insisted on, and such a comparison between Bréteuil and Teddington had been taken in hand recently, but has been interrupted by the war. The results of investigations, which were undertaken on the proposal of Sir David Gill, to ascertain the changes caused in a wire by constant use at normal tension are set out; and the results of the comparison made with twelve wires from four to six times yearly over the period 1908 to 1916 in continuation of an earlier series, 1904 to 1907, show well the stability of these wires when carefully handled under favourable conditions.

Three notes on the expansion of invar and the effect of mechanical and thermal treatment upon it conclude this very useful handbook on the use of these wires in field measurement, and the precision which may be attained with them.

More can be said regarding the practical use of these wires in the field and the various difficulties that have from time to time been encountered; but as these lie outside the personal experience of the authors they have not been specially dealt with in this volume.

H. G. L.

PHILOSOPHY.

A Defence of Idealism: Some Questions and Conclusions. By May Sinclair. Pp. xxi + 396. (London: Macmillan and Co., Ltd., 1917.) Price 12*s*. net.

MISS MAY SINCLAIR'S "Defence of Idealism" is written with a most refreshing ease and freedom from technicality. It is the work of an amateur, but of an amateur who has read much and sees how arguments that are usually thought to be abstruse bear closely upon problems which should command the interest of every thinking person. Professional students cannot fail to regard such a book as a gratifying proof of the vitality of philosophy in this country.

The idealism which Miss Sinclair sets out to defend is not idealism in general, but idealistic monism. It would have been well if Miss Sinclair

had said plainly what she understands by this doctrine, and how precisely it differs from other "isms" to which Miss Sinclair is opposed. Sometimes she speaks as though the enemy were the New Realism, sometimes Pluralism, sometimes Pragmatism, sometimes something else. To be definite is not to be dull, necessarily; it would not have detracted from the readableness of Miss Sinclair's book if she had made plainer just why she disagrees with William James, M. Bergson, and Mr. Bertrand Russell, to mention three of the contemporary names which figure most frequently in her pages. However, let us take the book as we find it. To a vague and there-or-thereabouts doctrine one can offer nothing but a criticism correspondingly inexact.

It is manifest that Miss Sinclair is, above all, anxious to safeguard the higher elements of our world, the reality of moral experience, the reality of religious experience, and our hope of existence in a future state. Miss Sinclair holds that these valuable elements are gravely threatened both by Pragmatism and by the New Realism. In her quarrel with the New Realists, the present reviewer would not wish to intervene. Frankly, he has never been able to understand the logical basis of the New Realism, nor what bearing (if any) that doctrine has upon the vital problems which thoughtful people expect philosophy to illuminate. But in regard to Pragmatism Miss Sinclair seems to have gone gravely astray. The basis of the Pragmatist's belief is a kind of optimism, or, to speak more accurately, a kind of meliorism—that is, a belief that the constitution of the world is good upon the whole; and this implies that the world is such that the higher needs of man's nature are sure to receive satisfaction. If the analysis of human nature goes to show that man needs assurance of the reality of moral and religious experience, and needs belief in a life after death, then that is *pro tanto* a reason for holding that the universe will satisfy those needs. Is this illogical, as Miss Sinclair seems to think? If so, where is the flaw in it? It is quite a mistake for Miss Sinclair to think that "Pragmatism has no logic," and that "it is spineless." On the contrary, it has all the logic that is worth having.

OUR BOOKSHELF.

An Ethical System Based on the Laws of Nature. By M. Deshumbert. Translated from the French by Dr. L. Giles. With a preface by Dr. C. W. Saleeby. Pp. ix+231. (Chicago and London: The Open Court Publishing Co., 1917.) Price 2*s*. 6*d*. net.

HUXLEY maintained that ethical progress depends, not on imitating the cosmic process, but on combating it. M. Deshumbert proclaims a not less exaggerated theory that the whole duty of Man is to bring his conduct into harmony with Nature. Organisms are rich in adaptations which secure self-preservation and the perpetuation of the species; and if man is to continue to survive, he must become increasingly fit in these directions. Organic Nature, historically regarded, shows, on the whole, a progressive differentiation and integration of the nervous system; and man must follow this trend. But among animals it is often clear that success has rewarded not merely strength or cunning, but sociality and care for the offspring as well; and Man must vie with Nature in parental care and mutual aid.

This is familiar good sense, well worth restating in the author's picturesque way, with a pleasant *note personnel*; but we cannot pretend to see any stability in the thesis that "the Good is everything that contributes to the harmonious expansion of the individual and of the groups of which he is a member." For the "harmonious expansion" includes, for man, goodness; and one of the evidences of an evolutionary process being progressive or integrative is just that it leads on to the good. The author seems to wander round in a circle; but it is not a dull circle. His book contains an interesting collection of examples (not always quite accurate) of self-preservative adaptations and parental care; and quite a feature is made of what the Rev. J. G. Wood once gathered together in a suggestive volume—anticipations of man's devices by animals.

Much salutary counsel, sometimes a bit prosaic, is given, by attending to which the sum of human happiness and effectiveness would be greatly increased. It is obvious that man may strengthen his hands and avoid many gratuitous hindrances by regulating his life biologically or physiologically, but we should not call this an ethical system. The book has appeared in at least seven languages—and it cannot but be useful practically. But it does not rise to its title.

The Munition Workers' Handbook. By Ernest Pull. Second edition. Pp. 158. (London: Crosby Lockwood and Son, 1917.) Price 2*s*. 6*d*. net.

THIS little book opens with a brief treatment of workshop arithmetic, mensuration, and geometry, presented in a simple manner suitable for those who have taken up munition work temporarily, and probably forgotten, through disuse, most of the mathematics acquired at school. The composition, mode of manufacture, and strength of iron, steel, and other common materials are then explained. This section of the book should certainly encourage the worker to take a more intelligent interest in workshop processes. Illustrated descriptions of workshop tools are then given, including a good account of the use of micrometers. This section of the book should prove very useful. The following chapters are devoted to workshop operations, such as lathe work, drilling, tapping, screwing, bench work, planing, shaping, milling, and gear-cutting. The author clearly has intimate knowledge both of the subjects dealt with and of the requirements and limitations of the class of worker addressed, and has been successful in producing a book well adapted for the purpose in view. Its merits are such as to lead us to believe that the book will outlast the special conditions created by the war.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Magnetic Storm and Aurora, December 16-17.

THE following details of a noteworthy magnetic storm and aurora, which occurred on December 16–17, are communicated by permission of the Director of the Meteorological Office. C. CHREE.

Kew Observatory, Richmond.

ON the magnetic traces at Kew Observatory, Richmond, Surrey, there were indications of disturbance shortly after 8h. on December 16, but no striking movements until after 14h. (2 p.m.). Activity was greatest between 16h. and midnight of December 16, but some considerable movements appeared after midnight, and the disturbance did not die down until after 4h. on December 17. The range of declination (D) was about 34′, the ranges of horizontal force (H) and vertical force (V) being respectively about 400 γ and 250 γ. The needle reached its extreme westerly position about 14h. 40m., and its extreme easterly position just after 21h. Its largest continuous movement was a swing of 23′ to the west, occupying about thirty-five minutes, and ending just after 22h. The highest and lowest values of H occurred about 17h. and 21h. 15m. respectively; between these hours there was a general tendency to fall. A very rapid movement in H ended just before 21h. 15m., the element falling 215 γ in less than ten minutes. Between the end of this movement and 2h. 25m. on December 17, H rose almost 350 γ.

From 14h. 30m. until after 21h. on December 16 the D trace showed, superposed on a gradual drift to the east, a series of oscillations with a mean period of about twenty-two minutes. The H trace also showed a series of oscillations between 15h. and 18h., and the oscillations in the two elements were roughly in phase, increase in H going with westerly movement of the needle. The changes in V were of a normal kind, the value of the element being raised between 15h. and 22h. on December 16, and depressed in the early hours of December 17. The V trace was almost free from short-period oscillations, and these were also less conspicuous in the D and H traces than is usual with so large a disturbance.

The following particulars are reported from Eskdalemuir Observatory, Dumfriesshire, where the magnetographs record the north (N), west (W), and vertical (V) components of magnetic force:—

Time of commencement 8h. 17m. G.M.T. on December 16.

		h.	m.	Range
Maximum of N	at	17	23	638 γ
Minimum „	„	21	27	
Maximum of W	„	17	16	587 γ
Minimum „	„	21	14	
Maximum of V	between	17	20	
	and	17	35	$>579\ \gamma$
Minimum „	at	21	18	

These ranges, it will be noticed, especially that in V, are much larger than those recorded at Kew Observatory.

After the occurrence of the minimum values about 21h. 20m., the Eskdalemuir curves showed a recovery to about their normal positions; but just before 2h. on December 17 another disturbance was recorded, causing an increase in W and fall in N and V, the changes of force being approximately in N $-150\ \gamma$, in W $+80\ \gamma$, in V $-260\ \gamma$.

Observations of aurora on December 16 have been reported from many stations in Scotland and Ireland. At Eskdalemuir aurora was first noticed at $20\frac{1}{2}$h., when it appeared as a glow to W.N.W. At 21h. an arc extended from about N.W. to about N.E., with green streamers extending towards the zenith. At 21h. 10m. the arc had disappeared, but the whole northern half of the sky up to the zenith was glowing brightly. At $21\frac{1}{4}$h. the glow was less extensive. It was noticed at this time that the streamers radiated to a point about 10° from the zenith towards the south (*i.e.* the radiant point had an elevation of about 80°, an azimuth of about 180°). The streamers were not thin and sharply defined, as is usually the case, but vaguely defined patches of light which glowed brightly. At $21\frac{1}{2}$h. the principal glow was to the W. and W.S.W., but it was also plain to the N.W., N., and N.E. The natural inference was that the centre of the arc of the horizon from which the disturbance proceeded had changed azimuth from N (nearly) to W (nearly) between $21\frac{1}{4}$h. and $21\frac{1}{2}$h., but the radiant point of the streamers did not change appreciably in position. A slight glow was still visible in the N.E. at 23h.

At Aberdeen Observatory, Mr. Clarke, the observer, reported a fine auroral display on December 16. From 16h. 45m. to 21h. it was of a comparatively stable character. Until 18h. there was a single curtain-arc, with crimson, yellow, and green colouring. Between 18h. and 21h. there were several similar arcs, coloured from yellowish-green to bluish-white. After 21h. the type altered, streamers appearing all over the sky, accompanied by a corona. This second auroral phase would seem to have synchronised with the very rapid fall of magnetic horizontal force at Richmond.

At Rothesay, according to the observer, Mr. J. Davidson, the aurora was very fine indeed. Along with extra long streamers were waves of red and white light, the whole centring overhead and forming an immense "dome" (corona), where both streamers and waves of light centred. The red waves came mostly from N.W. and N.E.

At Fort Augustus the "dome" was in the zenith at 21h. 15m. The most southerly station from which observations have been received at present is Seskin, near Waterford, where the aurora was "moderately bright" at 21h., and "faint" at 22h. The observer, Mr. Ernest Grubb, writes:—"The aurora on Sunday was much brighter at Mount Mellick, fifty-seven miles north of here, and very much brighter at Belfast, 174 miles north of here."

At Southport "a very fine display of streamers" was seen early on December 17, between $2\frac{1}{2}$h. and $2\frac{3}{4}$h., and therefore corresponded with the second magnetic disturbance at Eskdalemuir.

SOURCES OF POTASH.

AS is well known, the world's supply of potash during the last three years has been greatly curtailed owing to the present isolation of Germany, and compounds of potassium have, consequently, greatly increased in price. This, of course, has acted adversely on the interests of agriculture, of medicine, and of numberless processes in the arts which are more or less dependent upon the use of potash compounds. Up to within comparatively recent times such potash as the world needed was obtained from sea-water, either directly, or indirectly through the medium of sea-

plants (*kelp* or *varec*); by the incineration of land-plants (wood-ashes); from *vinasse*, or the residue left on distilling fermented beetroot molasses; from *suint*, or the "yolk" of sheep's wool, etc. These still continue to be sources of potash, but they are of comparatively subordinate importance when compared with the relatively enormous output of the Stassfurt deposits. All these sources, including those of the Stassfurt beds, are ultimately dependent on the primitive rocks of the earth—that is, to the decomposition of such minerals as potash felspar, potash mica, and the vast number of zeolites and other silicates which make up much of the rock-forming material.

Felspars are, in fact, the most abundant minerals in the earth's crust, constituting, according to Dr. Hatch, about 48 per cent. of the whole, the potash felspars forming the predominant proportion. Orthoclase, when pure, should contain 16·9 per cent. of potash (K_2O), but such a theoretical figure is never reached, owing to a greater or less admixture of soda. About 12 per cent. of potash is the usual amount, which is rather more than the average percentage in the Stassfurt deposits. Many suggestions have been made from time to time to extract the potash from the two chief varieties of potash-felspar, viz. orthoclase and microcline, and from the intrusive igneous rock known as pegmatite, which is a mixture of quartz and felspar; and a large number of patented processes for this purpose are on record. It is said that upwards of one hundred patents on this subject have been taken out in the United States alone. One of the most promising of these was that of E. Bassett, who, in 1913, patented in the United States and Canada a process based on the discovery that powdered potash-felspar, when fritted with common salt, was decomposed, with the formation of potassium chloride, which could be leached out from the sintered material, and obtained sufficiently pure for technical purposes by fractional crystallisation.

This process was independently discovered, and has been carefully studied, by Mr. E. A. Ashcroft, who has brought it to the notice of the Institution of Mining and Metallurgy in a paper which has just been published (Bulletin No. 159, December 13, 1917). The reaction is a reversible one, and for its success in affording the maximum yield of potash certain conditions of fineness, temperature, duration of heating, and absence of air and moisture must be observed, which, however, would seem to be easily reached in practice. Large deposits of suitable material are to be met with in Great Britain, notably in Cornwall and in various parts of Scotland and Wales. Other localities occur in Ireland. Some of these are already worked for pottery purposes, but others, as in Sutherlandshire, on the extreme north-west coast of Scotland, are untouched, and would be eminently suitable sources of supply, and capable of yielding some 20,000,000 tons of material without going below visible outcrops.

Considerations of space prevent any fuller analysis of Mr. Ashcroft's proposals, but we are inclined to concur in his general conclusion that from a purely commercial point of view the attempt to work these Scottish deposits seems fully justified as likely to prove remunerative, and we further agree with his contention that, given the raw material of the potash trade (the chloride), manures and all other potash products can be produced at least as favourably in this country as in Germany, and that an important section of German trade may thus be wrested from her, whilst our own urgent needs for munitions of war, for the soil, and for the chemical industries may be supplied.

The Stassfurt deposits occupy an extensive basin in the North German Plain, in Prussian Saxony, close to the borders of Anhalt. The brine-springs which they furnish have been known and intermittently worked since the early part of the thirteenth century, but they ceased to be remunerative, as sources of common salt, in the first years of the nineteenth century, and their working was abandoned. In 1839 the Prussian Mining Office commenced a systematic examination of these deposits, and put down a number of borings in different parts of the area, with the result that the potash formations were found to occur in practically only one locality, near the River Bode, not far from Magdeburg. During the last third of the preceding century a new industry sprang up and the villages of Stassfurt and Leopoldshall, from being wholly insignificant places, became the centres of a numerous population.

The conditions under which the Stassfurt deposits have been formed were the subject of elaborate inquiry by van't Hoff and his coadjutors so long as the eminent Dutch chemist lived. Although his interpretation cannot be said to be wholly satisfactory, the investigation greatly elucidated the mode in which the beds are supposed to occur, and rendered it very probable that similar deposits will be found in other parts of the world. Indeed, their existence has already been proved. In 1909 large deposits of sylvine, or potassium chloride, were discovered in Upper Alsace, in an area of about 200 sq. km., near Mulhouse. Two strata were found, the upper 3 ft. thick, the lower more than 16 ft. thick at a depth of from 1600 ft. to 2100 ft. This field, unlike that of North Germany, seems to be continuous, without faults, and is of more recent geological origin.[1]

The issue of *La Nature* for November 24 contains an interesting account of what has been allowed to transpire concerning these Alsatian beds, from which the following particulars are taken. The deposits, although continuous, are far from being horizontal or uniform. On the contrary, they are folded and irregular. The lower layer of sylvine is surrounded and covered, throughout the whole of its extent, by the upper layer, arranged somewhat in the form of an ellipse, in plan not unlike, indeed, a painter's palette. At the edges the saline layers gradually thin out and disappear. From their great depth they are naturally at a high temperature, not less than 48° C. From statements made in 1912 it was calculated that the upper layer of

[1] Cf. Prof. Lunge in Thorpe's "Dictionary of Applied Chemistry."

sylvine contained about 98,000,000 cubic metres, distributed over 84,000,000 square metres, whereas the lower layer amounted to 603,000,000 cubic metres, spread over an area of 172,000,000 square metres, equivalent in round numbers to 1,500,000,000 tons of potassium salts, or 300,000,000 tons of pure potash. The first borings were made at Wittelsheim (originally in 1904, in searching for coal), and some fourteen others have been made over different parts of the area. The salt began to be won in 1910, and in 1912, from the Amelia mine, with 200 men, the daily output reached 300 tons. The mineral, brought to bank, was crushed and powdered and either treated directly for the manufacture of "muriate" or exported.

The potash layers are composed of bands, alternately red and grey, consisting principally of a mixture of sylvine and rock-salt. The red bands, coloured with ferric oxide, contain the principal amount of the potash salt, whereas the grey consist mainly of common salt. In addition there are found thin layers of argillaceous schist and anhydrite. The content of potassium chloride varies from 20 to 68 per cent., and rarely falls as low as 10 per cent. The raw products contain only insignificant quantities of magnesium salts and may, therefore, be used directly in agriculture after grinding. In this respect they are more advantageous than the Stassfurt salts, which need separation from the large quantities of associated magnesium salts. The Reichweiler factory is capable of treating daily about 260 tons of the raw mineral, producing from 40 to 50 tons of pure potassium chloride. The content of bromine is so small as not to be worth extraction.

The production of Alsatian potash is carefully regulated by the German Government, and by the law of May 25, 1910, the Amelia mine, the only one actually at work in Alsace, was allowed to produce no more than 1·46 per cent. of the total yield of the Empire, *i.e.* 9000 tons of pure potash, or 45,000 tons of raw salt, corresponding with an extraction of fifteen wagons per diem, far below what it was capable of affording. At the beginning of the war, in spite of some improvement in the situation, the fifteen Alsatian mines, capable of yielding in the aggregate about 800,000 tons per annum, were allowed to sell only 80,000 tons, and the total amount reserved to Alsace was permitted to be only about one-tenth of the German production. This action is, of course, due to the attempts of the German authorities to control and strengthen the monopoly they practically possess—a condition which would be altogether modified by the return of Alsace to France, and by the *rôle* which the State mines of Stassfurt might be made to play in the case of a war indemnity by Germany.

Of the other considerable natural deposits which are known to occur, the most important are those of Spain and Abyssinia. The Spanish beds occur at Suria, in Catalonia, and to-day belong to the Solvay Company. They have been found at depths of from 40 m. to 60 m., but certainly extend much deeper. They date probably from the end of the Eocene or the beginning of the Oligocene period and are widely distributed, the potash salts occurring irregularly mixed with rock-salt. The potash compounds consist of carnallite and sylvine in layers of an intense red colour, with alternate reddish layers of common salt. The richest zones appear to follow anticlinal folds running from south to north to Cardona, Suria, and Callus. The area explored is only some 230,000 square metres, but it is said to contain about two and a half million tons of carnallite and nearly a million and a quarter tons of sylvine in local thicknesses of 17 m. of carnallite and 3·75 m. of sylvine. At present these Spanish deposits are not utilised, owing to the influence of Germany on Spanish affairs. The Cortes was offered a Bill in order to promote the working of the mines, but it was opposed by a faction in the interests of Germany, and no result followed. A Royal decree in June, 1915, modified the conditions, but these were still so restrictive that the Solvay Company was prevented from exploiting the mines. On the other hand, certain Spanish corporations, working in concert with the German syndicate at Stassfurt, have obtained concessions in the vicinity of Cardona, and State reservations have been created in the provinces of Barcelona and Lerida; but no further action has been taken, ostensibly on the ground that the Spanish Geological Institute has not yet completed its explorations.

The Abyssinian deposits belong to Italy. They occur in Erythrea, at 90 km. from the coast to the south-east of Massaoua, and at 10 km. to the north of Atel Bad in long. 40°, close to the Italian frontier. Their exploitation has hitherto been very difficult, owing to the hostility of the Abyssinians. These conditions are now notably improved, partly by a more effective possession by the Italians, and partly by recent changes in the Government of Abyssinia, which is more favourably disposed towards the Allies. The deposits already furnish about 20,000 tons per annum. Not much is known concerning their physical characteristics or the conditions of their formation, but they are certainly much more recent than those of Alsace and Spain, which are Tertiary; they have probably been formed by the comparatively recent evaporation of an ancient arm of the sea running north and south, due to one of the great lines of rupture extending from Palestine and traversing the whole of the east of Africa along a region still of volcanic activity.

Conditions such as probably have produced the Stassfurt deposits are still at work and may be observed in several parts of the world operating over large areas, as, for example, in the Adji-Darja Bay, in the east of the Caspian Sea—a bay 2000 to 3000 square miles in extent, and almost entirely shut off from the Caspian by a bar. There is here a continuous separation of salt, estimated by Schleiden to be about 400,000 tons per diem, with an outflow of dense mother-liquor back to the Caspian, except where it sinks in the deeper parts of the bay, when the mother-liquor salts are gradually deposited. None of these areas has

been investigated with such care as that of the North German Plain, but the general conditions which have led to their production are seen to be similar, although local circumstances, especially the extent to which they were subjected to an intermittent influx of sea-water, have modified the nature, relative amounts, and distribution of their various saline constituents. T. E. THORPE.

NATIONAL POWER SUPPLY.[1]

THE interim report issued by the Coal Conservation Sub-committee presided over by Lord Haldane will be read with great interest, as it crystallises the considered opinions of eminent engineers. The committee has little difficulty in proving that the present system of electrical power distribution in this country is most uneconomical. If it had all to be done *de novo* the Committee would divide the country into some sixteen districts. In each district there would be several large inter-connected super-stations for generating electric power, and these would be controlled by a single authority. The sites of these stations would not be chosen, as they too often are at present, mainly to secure that the "rates" payable on the electric works may come to the local authority working the undertaking, but they would be chosen on the lines laid down by Kelvin in 1878. They would therefore be either near the pit's mouth, where coal dross could be used for working engines of the most economical type, or in places where plenty of condensing water is available, where coal transport is cheap, and where they would be near the centre of gravity of the probable demand. If this were done it is calculated that as many as 55,000,000 tons of coal would be saved per annum, a saving that would far more than counterbalance the interest payable on the new capital necessary.

We agree with the Committee that it is in the national interest that the change should be made as soon as possible, and we think that the probable saving that would be effected has been somewhat under-estimated. Both Mr. C. H. Merz and Mr. C. P. Sparks, who are members of the Committee, have shown by the stations they have designed the great commercial possibilities of "supply in bulk," and what a boon it is in industrial areas. They are not inviting the country to take any speculative risks—the pioneer work has all been done. Dr. Ferranti, Lord Crawford, and Mr. Ince thoroughly appreciated the main facts of the problems in 1888, when the Deptford power station was first designed.

The Committee is right in saying that the difficulties which stand in the way are "political" rather than "engineering." There are too many vested interests at stake—those of engineers as well as capitalists—to make the course of any national power supply scheme a smooth one. The suggestion of a Board of Electricity Commissioners is a good one, but the powers of the Board will have to be very carefully defined. Everyone will agree that the Board should be empowered to stop the extension or multiplication of uneconomical stations for public supply, and that it should aim at ultimately securing the adoption of a bulk supply scheme somewhat similar to that outlined in the report under notice.

It will be interesting to see how far the conclusions of the report will be endorsed by the Board of Trade Electric Supply Committee, which is at present sitting, and on which municipal engineers are represented. In any event the Sub-committee is to be congratulated on having made excellent and timely suggestions.

[1] Reconstruction Committee: Coal Conservation Sub-committee. Interim Report on Electric Power Supply in Great Britain. Cd. 8880. (London: Imperial House, Kingsway, W.C.2.) Price 3*d*. net.

ECONOMISING SUGAR.

OUR contemporary, *La Nature*, devotes an article in a recent number (December 1) to a consideration of the use of substitutes for sugar, in view of the present shortage of that commodity. Sugar is a foodstuff; but as a nutrient it can be replaced by other carbohydrates, such as those contained in farinaceous foods and vegetables. The essential thing as regards sugar is to find a substitute with sweetening properties. Glucose, obtained by hydrolysing starch with sulphuric acid, is the only sugar other than the ordinary supplies producible in large quantities; but it has a low sweetening power, is not economical, and has reached an almost prohibitive price in France. There remain the sweet chemical products, of which the two chief are dulcin and saccharin. Dulcin, para-ethoxyphenyl urea, is obtained from phenetidine and urea, and has about two hundred times the sweetness of cane-sugar. It has not, however, been much used as a sweetener, since saccharin is cheaper and much more effective. This compound, it may be recalled, has for its parent substance toluene—the coar-tar product which serves also to provide the explosive trinitrotoluene. In making saccharin, toluene is converted first into its sulphochloride and then into the sulphonamide, which is oxidised with potassium permanganate to produce orthosulphamidobenzoic acid. Saccharin is the anhydride, or imido-derivative, of this acid; it is claimed to be about five hundred and fifty times as sweet as cane-sugar. It is not very soluble in water, and is generally employed in the form of its sodium or ammonium salt (sucramine), both of which are readily soluble.

Before the outbreak of war saccharin was chiefly made in Germany, but had been produced in this country to a small extent, and the manufacture has again been taken up here quite recently. In France four factories have lately been equipped to produce it. As regards the raw materials, ordinarily these would be accessible enough and cheap enough, but at present there is, of course, a great demand for toluene, and potassium salts are scarce. Nevertheless, a certain quantity of toluene can presumably be spared for urgent wants, and there is no absolute necessity to use *potassium* permanganate as oxidising agent. In any case the French factories are proceeding with the manufacture, and, as our contemporary observes, "*la pro-*

chaine apparition de la saccharine sera la bienvenue."

The writer of the French article suggests that it might be well, perhaps, to utilise the saccharin solely for mixing with sugar, as is done in Italy. This economises sugar, since a smaller "ration" will suffice, and is better than selling a substance which has no nutritive value at all. Moreover, it would diminish the rather unpleasant after-taste of saccharin used alone, and would also facilitate the employment of certain nourishing foodstuffs, such as cocoa, rice, and farinaceous foods, which require sweetening to make them palatable to most people. A suggestion that saccharin might be therapeutically objectionable is dismissed as of no serious weight, in view of the experience obtained with it in the past.

In this country saccharin has already been employed to a small extent in a somewhat similar manner, namely, to sweeten milk-sugar for sale as a sugar substitute. The supply of milk-sugar, however, is restricted. If our own authorities have not already done so, they might perhaps find it worth while to consider the plan suggested by the French writer. Five hundred pounds of sugar *plus* 1 lb. of saccharin would have about the same sweetening value as 1000 lb. of sugar used alone.

NOTES.

THE trustees of the British Museum have been given notice by the Government that the museum is to be requisitioned as the headquarters of the Air Board. This decision will be received with dismay by everyone who possesses intellectual interests or understands the value of the collections in the galleries of the great building at Bloomsbury. To pack up and store away the many fragile objects in the museum in order to prepare the galleries for occupation means ruin to the specimens, and the ruthless undoing of careful organising work of many years. Sir Arthur Evans, president of the British Association, and one of the trustees of the museum, writes to the *Times* of January 2 to protest against the wanton sacrifice of national treasures involved in the hurried removal of specimens from their cases, or the alternative of letting them remain while the building is used as the headquarters of a combatant department. "Even the bare statement of this proposal," he remarks, "will cause a shudder to run through all civilised countries. Were it carried out it would cover the British nation with lasting obloquy. I write this with the hope that even at the eleventh hour the Government may recoil from a step which could not but provoke a deep and widespread indignation." If the British Museum represented the last extremity in housing the Air Board, the occupation of the building would have to be accepted as an inevitable consequence of conditions of war. We have not, however, reached a degree of national stress which would justify the outrage now contemplated; and we trust that immediate steps will be taken to induce the Government to find a domicile for the Air Board without dismantling our national museum and ruining many of the priceless treasures collected within its walls.

A LONG list of New Year honours was published on Tuesday. Among the names included the following will be familiar to scientific workers:—*K.C.B.* (*Civil Division*): Mr. A. D. Hall, F.R.S., Secretary to the Board of Agriculture; Sir George Newman, Principal Medical Officer to the Board of Education. *C.B.* (*Civil Division*): Mr. F. L. C. Floud, Assistant Secretary to the Board of Agriculture. *Baronet:* Prof. James Ritchie, Irvine professor of bacteriology, University of Edinburgh. *C.I.E.:* Mr. P. H. Clutterbuck, Indian Forest Service, Chief Conservator of Forests, United Provinces. *Knighthoods:* Mr. W. N. Atkinson, who has contributed largely to a knowledge of the dangers of coal-dust in mines; Dr. J. Scott Keltie, editor of "The Statesman's Year-Book," and for many years secretary of the Royal Geographical Society; Dr. A. Macphail, professor of the history of medicine, McGill University, Montreal. In addition a large number of medical men have received honours for services rendered in connection with military operations in the field.

THE report on the production of iron and steel in Canada during the calendar year 1916, which has just been issued by the Canadian Department of Mines, is of exceptional interest at a time like the present, when the preponderating influence of iron output upon the European war is daily becoming more evident. The main outstanding fact is that the production of pig-iron was just above one million statute tons, being an increase of 27·9 per cent. as compared with that of 1915. Only a small proportion, about 10 per cent., of the iron ore smelted was produced in Canada, a little more than half the remainder being Lake ore from the United States, smelted mainly in Ontario, and the rest consisting of Wabane ore from Newfoundland, smelted in Nova Scotia. Thus fully half the ore smelted is of British origin. The total production of iron ore in Canada was only about 250,000 statute tons, approximately one-half of which was smelted within the Dominion and one-half exported to the United States. It is noteworthy that Canada produced in the year in question 28,628 tons of ferro-alloys, including ferro-silicon, ferro-molybdenum, and ferro-phosphorus, smelted in electric furnaces. The total steel production of Canada was 1,428,429 short tons of ingots and castings, being an increase of 40 per cent. above the previous year; of this amount 1,397,703 short tons were ingots, the remainder being castings. Practically all this is open-hearth steel, only 1400 tons of Bessemer steel having been made, whilst about 26,000 tons of steel were made in electric furnaces. The quantity of scrap worked up is quite considerable, amounting to about 47 per cent. of the steel produced and 71·5 per cent. of the pig-iron charged. The increase in production shown all round is very satisfactory, and indicates how energetically Canadian iron-masters have striven to contribute to the Imperial output of this all-important material. There is also a highly significant piece of information, namely, that the production of iron ore in the United States in 1916 was as much as 75½ million statute tons, or an increase of twenty million tons above the 1915 production; seeing that the iron in this increase is by itself nearly equal to the whole iron production of Germany, it is very evident that the part that America can play in the great war is likely to prove a decisive factor before very long.

WE learn with regret that Prof. C. Christiansen, professor of physics in the University of Copenhagen from 1886 to 1912, died on December 28, at seventy-four years of age.

THE *Chemist and Druggist* announces that Dr. M. Louis Martin, head of the Pasteur Hospital at Paris, and Prof. Albert Calmette, director of the Pasteur Institute at Lille, have been unanimously elected sub-

directors of the Paris Pasteur Institute in succession to the late Profs. Metchnikoff and Chamberland.

AFTER a succession of shocks, which began early on December 26, Guatemala City was destroyed by an earthquake on Saturday, December 29. It is reported that the whole city is in ruins, and that at least one thousand people have been killed.

MR. E. E. LOWE, honorary secretary of the Museums Association, has been invited by the Ministry of Food to organise and control food economy exhibitions throughout the country. The Leicester Museum and Library Committee has released Mr. Lowe temporarily in order that he may undertake this important national work.

MAORI pictographs have long been known to exist in the limestone caves and rock-shelters of the South Island, New Zealand, but recent examination by an American ethnologist, Dr. Elmore, has proved them to be of unexpected interest. On the suggestion of Dr. Benham, the museums of Wellington and Auckland have joined forces with the Otago Museum, and have removed a number of slabs from the caves for permanent preservation in the three museums.

ON January 2 the Institution of Civil Engineers completed the hundredth year of its existence, having been established in 1818 at a meeting of eight engineers at the Kendal Coffee House in Fleet Street. At the next ordinary meeting of the institution on January 8, before the discussion of papers, a statement commemorative of the founding of the institution will be made, present conditions precluding more formal celebration of the centenary.

MR. T. F. CHEESEMAN, author of the "Manual of the New Zealand Flora," has formed by his own private efforts, extending over forty-five years, a large collection of New Zealand plants. To this the trustees of the British Museum, in recognition of Mr. Cheeseman's valuable help, have recently added a nearly complete set of the plants collected in New Zealand by Banks and Solander (1769–70). The collection and its cabinets now occupy a room 25 ft. long, and Mr. Cheeseman has offered to present the whole to the Auckland Museum, of which he is curator, if that institution will engage to place it in a separate room and maintain it as a public herbarium. Since there is as yet no botanical museum in New Zealand, this offer is certainly one to be accepted.

THE report of the council of the Scottish Meteorological Society, adopted at the general meeting of the society held on December 20, states that the council has continued to keep steadily in view the encouragement of rainfall observation in Scotland, and there are available in the Journal monthly and annual figures for fully 750 stations. Much time has been devoted to tabulating and arranging the great mass of rainfall statistics now available. There are at present 261 members of the society, of whom eighty-one are life members. The council for the ensuing twelve months is constituted as follows:—*President:* Prof. R. A. Sampson; *Vice-Presidents:* Mr. M. M'Callum Fairgrieve and Dr. C. G. Knott; *Council:* Prof. T. Hudson Beare, Dr. J. D. Falconer, Mr. J. Mackay Bernard, Mr. D. A. Stevenson, Mr. R. Cross, Mr. S. B. Hog, Mr. G. Thomson, Dr. A. Crichton Mitchell, and Mr. G. A. Mitchell; *Hon. Secretary:* Dr. E. M. Wedderburn; *Hon. Treasurer:* Mr. W. B. Wilson.

THE last report of the Bristol Museum and Art Gallery describes an excellent scheme for popularising the collections. A large hall capable of accommodating 300–400 wounded soldiers was opened. The men were received by guides, who explained the pictures and exhibits; lantern lectures and demonstrations by members of the staff were organised, and the scheme was supported by the Lord Mayor and other leading citizens. "The keen interest and enthusiasm of the soldiers reacted upon the staff, who found the work a delight, and many men returned on leave-days to continue the studies thus begun."

IN this country we are unfortunately still prone to regard our museums as places of "innocent amusement" rather than as centres of education. It is otherwise in America. There the Natural History Museum, for example, is regarded as an indispensable factor in national well-being, serving both as a centre of instruction to the general public as to the natural resources of the country, and as the repository of the material necessary to those engaged in the development and conservation of such resources. To further these aims the American Museum of Natural History publishes an admirable *Museum Journal,* ably written and most profusely illustrated. The November issue of this journal well demonstrates the range of these activities, for it contains, among other things, a number of exceptionally fine photographs of the bird-life of the Falkland Islands, including nesting colonies of penguins, king-shags, and giant petrels, and two valuable accounts of explorations in New Mexico and the Navaho region. The former deals with the ancient and buried cities of the La Plata region, while the latter describes the customs of the Navaho Indians, incidentally directing attention to cave-dwellings of extinct peoples awaiting investigation.

THE theory that early society was organised on the patriarchal model, popularised by Sir H. Maine in his work on "Ancient Law," was generally accepted until the priority of matrilinear kinship was urged by writers like Bachofen and McLennan. Their view was supported by the investigations into the organisation of the Central Australian tribes by Messrs. Spencer and Gillen. At present among European anthropologists the priority of matrilinear kinship is generally recognised. But two eminent American anthropologists, Dr. Lowie and Dr. Swanton, have questioned its existence among the American Indian tribes. Their conclusions have been criticised in an elaborate paper by Dr. E. Sidney Hartland (Memoirs of the American Anthropological Association, vol. iv., No. 1), in which he proves that in most of these tribes there is evidence of a previous stage of matrilinear organisation, and, where it is wanting, its absence is due to vicissitudes and external influences to which these tribes have been exposed.

UNDER the name of the "Inometer," Prof. T. Johnson, of the Royal College of Science for Ireland, has introduced a new form of food chart, constructed on the principle of the thermometer. The degrees on the scale represent large Calories, and the principal points are placed at 4000 Cal., 3500 Cal., 3000 Cal., 2500 Cal., and 2000 Cal. These represent the food energy (expressed in Calories) requisite for the performance of a day's work, ranging from heavy muscular work at 4000 Cal. to sedentary work at 2500 Cal., the energy expenditure of a man resting in bed being placed at 2000 Cal. In addition, there are interpolated at various points on the scale the numbers of Calories furnished by definite quantities of a variety of common foods, together with their cost in Dublin in April, 1917. The chart is accompanied by eight pages of letterpress, in

which is given a clear and simple account of the uses of food, together with suggestions for the making up of dietaries, having regard to both the economic and patriotic aspects of food problems in war-time. The pamphlet is published by the Department of Agriculture and Technical Instruction for Ireland, and can be had free on application.

A SHORT paper by Mr. E. S. Goodrich in the *Quarterly Journal of Microscopical Science* (vol. lxii., part 4) throws considerable light on the interesting problem of the homologies of the cœlomic spaces in various groups of the animal kingdom. The "proboscis pores," which lead from the proboscis cœlom to the exterior in Balanoglossus, are believed to be represented in Echinoderms by the water pore, and in Amphioxus by the opening of Hatschek's pit, as originally suggested by Bateson. But the anterior cœlomic sacs of Amphioxus, one of which becomes metamorphosed into Hatschek's pit, are homologous with the premandibular somites of Craniates. The cavities of these somites may develop a tubular connection with the hypophysis, which is to be identified with the proboscis pore of lower forms, while the hypophysis itself is the homologue of the ciliated "wheel organ" in the buccal cavity of Amphioxus. These views are supported by an interesting reconstruction of part of the head of an embryo torpedo.

IN the Transactions of the Royal Society of South Africa (vol. vi., part 1, 1917) Mr. P. A. Wagner publishes an exhaustive monograph on the national game of skill of Africa. The game, in one form or the other, is played in rows of holes scooped out of the ground, or on wooden, stone, or even ivory boards. As a matter of fact, it is not confined to Africa, being played in Syria, Arabia, Bombay, Ceylon, the Malay Peninsula, and along the entire southern coast of Asia as far as the Philippine Islands. It is essentially a war game, two players, or sides, directing a contest between armies of equal strength, the object being the capture or "killing" of "men," who are represented by small stones, seeds, shells, or fragments of dried cow-dung. It is often played for a stake, but it is certainly not a gambling game, as some writers have maintained. It is also incorrect to say that it is very intricate, though it does require a certain facility in ready reckoning. It is of considerable antiquity, being known to the Arabs of the Middle Ages, and stone boards and fragments of others have been found in the neighbourhood of ancient ruins in Rhodesia. The problem of the methods by which this game appears in such a wide area is interesting, but is not dealt with by Mr. Wagner.

IN a study of the natural regeneration of the Douglas fir and other conifers in the Pacific coast forests of the United States, published in the *Journal of Agricultural Research*, vol. xi., pp. 1–26 (October, 1917), J. V. Hofmann shows that when a large area is either burnt or cut away, the complete restocking which usually takes place does not result from the seeds that are scattered by surviving trees on the area or in its vicinity. The distance from the parent tree to which seed is carried by the wind is very small, 150 to 300 ft. Consequently, if only wind-dispersed seed germinated, the regeneration of a large area would not be completed until after the growth of several generations of trees. The reproduction is never a gradual creeping out from surrounding bodies of green trees, but is a sudden taking possession of the whole area by a dense growth of seedlings. The regeneration is really effected by the seed which is stored in the ground amidst the litter and humus, which are not destroyed in the swift passage of the ordinary forest fire. The litter is found on examination to contain a large number of germinable seed. The ordinary form of succession is the replacement of the forest almost immediately by the same species as composed the original stand, and usually in the same proportions. This paper is well illustrated with diagrams and photographs. One plate is a view of the reproduction on the Yacolt "Burn" of 1902 in the Columbia National Forest. The extent devastated by fire is 604,000 acres. No green trees are visible, yet there are seedlings growing among the snags over the whole area.

PROF. P. L. MERCANTON, in the *Revue générale des Sciences* for November 30 last, discusses the results of the more recent observations on the advance and retreat of glaciers, especially Alpine. Systematic work was begun by Prof. Forel thirty-seven years ago in the Swiss Alps, and for at least thirty of them the movements of the Rhone Glacier and the two at Grindelwald have been carefully noted. Those on the northern side of Mont Blanc have also been studied, and similar work is now being carried on in other icefields. But the main advances and retreats of those glaciers and a few others in the Alps are known for fully three centuries, and estimates of their periods have been attempted. These do not correspond with Wolf's eleven-year period, or with the thirty-five-year one of Brückner. Some causes affect their movements other than the snowfall in the upper region—that of the névé—and the ablation due to temperature changes in the lower; for of two adjacent glaciers, one may be advancing while another is retreating. Recent observations, as Prof. Mercanton points out, indicate that the volume and the length of a glacier can to some extent vary independently, or, in other words, that the ice moves down a valley from the more expanded névé basin at its head, not with perfect uniformity, but with local intermittence, so that a belt near the end may be swelling up in a wide mound, and thus the actual volume of ice be increasing, while the end itself is in retreat. Evidently, as Prof. Mercanton observes, the subject of glaciers and their history is not yet exhausted.

PROF. FILIPPO EREDIA has recently published in the *Bollettino d'Informazione* of the Italian Colonial Office a useful note on the frequency of snow in Tripoli and in Algeria. In the last-named country at sea-level snow is rare, since only one fall in the whole year may be expected. At a height of 600 metres six falls per annum occur on the average, while at double this elevation twenty-five falls are experienced. In Algeria and Tunisia the most frequent and extensive snowfalls occurred in the winter of 1890–91, while 1884, 1904–5, 1913, and 1915 were also characterised by abundant snowfalls. Some interesting photographs are given of snow scenes in Tripoli during the snowstorms of February, 1913, and February, 1915.

AN interesting instance of the way in which the solution of a problem in one branch of science provides or aids in the solution of a problem in an entirely different branch was brought before the Institution of Mechanical Engineers on December 14 by Messrs. Griffith and Taylor in a communication entitled "The Use of Soap Films in Solving Torsion Problems." The authors show that the equations which determine the stress in a rod of any section subjected to twist are identical with those which determine the slope of a soap film formed in a hole of the same shape as the section, in a horizontal plate above which it protrudes owing to a small excess of pressure on the under-side of the

film. The slope of the film at any point is found by an optical method, and a number of diagrams of the contour lines for various sections are given. The diagrams thus obtained lead to a general method of calculating the torsional strengths of rods of difficult sections, which gives results much more accurate than those at present in use.

MESSRS. P. L. GAINEY and L. F. Metzler are the authors of an interesting article entitled "Some Factors affecting Nitrate-Nitrogen Accumulation in Soil" in the *Journal of Agricultural Research* (vol. xi., No. 2). The soil employed in the work described was an Oswego silt loam, and some preliminary experiments led to the conclusion that the amount of nitrate produced is independent of the quantity of soil, of its depth (provided the soil was left loose), of the ratio of the exposed surface of the soil to its weight, and of the shape and size of the containing vessel. These points having been determined, experiments were made to ascertain the effect of variations of the depth of column, moisture content, and compactness of the soil upon nitrate accumulation. From the results of these experiments the following conclusions are drawn: First, that the amount of nitrate increases with the compactness of the soil, provided that the latter is not saturated with moisture. Secondly, the optimum moisture content of the soil (with any degree of compactness tested) is approximately two-thirds of the total amount of moisture it will retain, and provided the moisture present does not exceed this optimum, the aeration will be adequate to a depth of one foot, however compact the soil. Thirdly, the accumulation of nitrate increases with increasing depth down to 2 ft. so long as the moisture does not exceed two-thirds saturation. Fourthly, that nitrate accumulates more rapidly in unbroken soil columns than in pulverised soil (in a column of soil uncultivated for seven years aeration was far greater than that required to maintain aerobic conditions). The authors point out that such beneficial effect as cultivating the soil may have upon its biological activity cannot be attributed to increased aeration, because the experimental data available for normal field soils indicate that obligate aerobic conditions almost invariably exist within the first foot of surface.

IN the *Atti dei Lincei*, vol. xxvi. (2), 6, Dr. Quirino Majorana describes an experiment performed with the object of testing whether reflection from a mirror in motion affects the velocity of light. For this purpose a number of mirrors were arranged symmetrically round a rapidly revolving wheel, so that a pencil of light could be reflected from a moving mirror, then from a fixed mirror, then from another moving mirror, the process being repeated any desired number of times so as to increase the effect, and the mirrors having a component velocity in the direction of the ray, and in a sense depending on that of the rotation. The change in the wave-length produced by the rotation was observed by a Michelson interferometer, the object being to ascertain whether this change was or was not the same as would take place if the velocity of light remained constant. Although the limits of error were considerable, it was found that the results led to the conclusion that reflection from a moving mirror does not change the velocity of light relative to the surrounding medium.

MESSRS. C. GRIFFIN AND CO., LTD., are about to publish "Transmission Gears: Mechanical, Electric, and Hydraulic, for Land and Marine Purposes," by E. Butler, and new editions of "Coast Erosion and Protection," by Prof. E. R. Matthews; "Mechanical Engineering for Beginners and Others," by R. S. McLaren, and "Treatise on the Principles and Practice of Harbour Engineering," by Dr. Brysson Cunningham. *Messrs. Crosby Lockwood and Son* announce a "Glossary of Aviation Terms" and "Aviation Engines," the former by Lieut. V. W. Pagé and Lieut. P. Montariol, and the latter by Lieut. Pagé. The same firm will also issue a new edition of "Refrigeration, Cold Storage, and Ice-making," incorporating the fourth edition of "Refrigerating and Ice-making Machinery," by A. J. Wallis-Tayler. "A Text-book of Naval Aeronautics," by H. Woodhouse and others, is promised by *Messrs. T. Werner Laurie, Ltd.*

OUR ASTRONOMICAL COLUMN.

NEW STARS IN SPIRAL NEBULÆ.—A full account of the discovery of a new star in the spiral nebula N.G.C. 4527 is given by Dr. H. D. Curtis in Lick Observatory Bulletin, No. 300. Photographs from various sources show that there was no trace of the star from early in 1900 until March 20, 1915, when it appeared to be of about 14th magnitude. On April 16 of the same year it had fallen to 15th magnitude, and was not certainly recognised in later photographs. Two novæ were afterwards discovered in photographs of N.G.C. 4321, and of these also the history is fairly complete. Including Ritchey's nova in N.G.C. 6946, six novæ have now been discovered in spiral nebulæ, four of them about 14th magnitude, and two brighter, one of the latter being observed in the Great Andromeda nebula in 1885. Dr. Curtis considers that the appearance of these novæ strongly supports the view that the spiral nebulæ are "island universes." The average maximum brightness of novæ which have appeared in our own galaxy is about magnitude 5, and if the galactic and spiral novæ have the same absolute brightness, the difference of about 10 magnitudes indicates that the spiral nebulæ in question are of the order of 100 times as far away as the galactic novæ, which are themselves known to have been very remote. Five additional novæ in spirals are included in a list given in *Popular Astronomy*, vol. xxv., p. 632.

"COMPANION TO THE OBSERVATORY FOR 1918."—The issue of this publication for 1918 closely resembles those of previous years. In addition to a convenient series of tables relating to the sun, moon, and planets, and the satellites of Jupiter and Saturn, it includes an extensive catalogue of meteor radiants, and tables giving the times of minima or maxima of a large number of variable stars. The list of double stars has been improved by the addition of the periods of revolution, so far as they have been determined, and it now includes practically all the visual binaries of known period. There is also a useful table of astronomical constants.

HYDERABAD OBSERVATORY REPORT.—The report of the director of the Nizamiah Observatory, Hyderabad, for the year ending October 5, 1917, is chiefly noteworthy as indicating that great progress has been made with the astrographic work. The catalogue for zone $-17°$ has been finally passed for press, and the greater part of that for $-18°$ is also in the hands of the printers. For zone $-19°$ 131 plates, containing 46,186 stars, were taken, measured, and reduced during the year, and fifty-three plates for zone $-20°$ were also taken and partially measured. Mr. Pocock is to be congratulated on having so quickly brought this institution to a high state of efficiency.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES, 1917.

Mathematics.—The Francœur prize to Henri Villat, for his work in hydrodynamics; the Bordin prize to Gaston Julia, for his memoir on the arithmetical theory of non-quadratic forms.

Mechanics.—The Montyon prize to René de Saussure; the Poncelet prize to Jules Andrade, for his work in applied mechanics, especially that dealing with chronometry.

Astronomy.—The Lalande prize to Robert Jonckheere, for his work on double stars; the Valz prize to Alexandre Schaumasse, for the discovery of the comet 1917*b*.

Geography.—The Gay prize to Henri Jumelle, for his books and memoirs on the geographical distribution of plants of economic value; the Tchihatchef foundation to Sir Mark Aurel Stein, for his explorations in Central Asia.

Navigation.—The prize of 6000 francs between Camille Tissot (4000 francs), for his studies of methods of protection in navigation, and G. Sugot (2000 francs), for his studies in theoretical and practical ballistics; the Plumey prize between Georges Sensener and L. Ballif (2000 francs), for their work entitled "Le Combat Aérien," and Edmé Bonneau (2000 francs), for his instrument designed to indicate at any time to aviators the position of their machine with respect to the vertical.

Physics.—The Gaston Planté prize to Henri Armagnat, for his work in the development of the French electrical industry; the Hébert prize to Hyacinthe Guilleminot, for his book entitled "Les nouveaux horizons de la Science"; the H. de Parville prize to Charles de Watteville, for his researches on flame spectra and the structure of flame; the Hughes prize to Amédée Guillet, for the whole of his researches in physics.

Chemistry.—Montyon prize (unhealthy trades) to Marius Picon and Marcel Lantenois (2500 francs), for their work on gas masks for use at the front; honourable mentions to Charles Dufraisse (1500 francs), for his chemical researches in connection with the war, and Pierre Savès (1000 francs), for his work on protection against asphyxiating gases; the Jecker prize to Emile Blaise, for the whole of his work in organic chemistry; the Cahours prize to Adolphe Lepape, for his work on radio-activity and the rare gases from mineral springs; the Berthelot prize to Gustave Vavon, for his researches on the addition of hydrogen to organic substances with platinum black as the catalyst; the Houzeau prize to (the late) André Sénéchal, for his work on chromium compounds.

Mineralogy and Geology.—The Delesse prize to Louis Gentil, for the whole of his researches in geology and physical geography in northern Africa; the Fontannes prize to Jules-Mathieu Lambert, for his palæontological work; the Victor Raulin prize to Léon de Lamothe, for the whole of his geological work; the Joseph Labbé prize to Georges Friedel, for his contributions to the geology of the Saint Etienne region; the James Hall prize to (the late) Jean Boussac, for his thesis entitled "Etudes stratigraphiques sur le Nummulitique alpin."

Botany.—The Desmazières prize to Carl Hansen Ostenfeld, for his memoir on the plankton of Danish seas; the Montagne prize to J. Pavillard, for the memoirs entitled "Recherches sur les Diatomées pélagiques du Golfe du Lion" and "Recherches sur les Péridiniens du Golfe du Lion"; the Jean Thore prize to Mme. Valentine Moreau, for her memoir on the phenomena of sexuality in the Uredineæ; the de Coincy prize to André Guillaumin, for his studies in the Burseraceæ; the de Rufz de Lavison prize to Marin Molliard, for his researches in plant physiology.

Anatomy and Zoology.—The Cuvier prize (in equal parts) between Ph. Dautzenberg and Paul Pelseneer, for their researches on molluscs; the Savigny prize to R. Jeannel, for his zoological exploration (with Ch. Allaud) in eastern Africa.

Medicine and Surgery.—Montyon prizes to Hippolyte Morestin (2500 francs), for his autoplastic work on the wounded, Ed. Delorme (2500 francs), for his researches relative to decalcification following war wounds, and Auguste Pettit (2500 francs), for his researches relating to the mode of action of various micro-organisms on the anatomical elements; three mentions (1500 francs each) to Léon Imbert and Pierre Réal, for their work on maxillo-facial surgery, to F. Rathery, L. Ambard, P. Vansteenberghe, and R. Michel, for their work entitled "Les fièvres paratyphoïdes B à l'hôpital mixte de Zuydcoote de Décembre, 1914, à Février, 1916," and to Giuseppe Favaro, for a work entitled "Richerche intorno al cuore dei vertebrati." The Barbier prize to E. Weill and Georges Mouriquand, for their researches on vitamines; from the funds of the Bréant prize 2000 francs to Jean Danysz, for his researches on the arsenobenzenes, 2000 francs to H. Gougerot, for his researches in dermatology, and 1000 francs to Maurice Courtois-Suffit and René Giroux, for their work entitled "Les formes anormales du tétanos"; the Bellion prize to Paul Fabre-Domergue, for his work on a practical method of sterilising oysters; the Baron Larrey prize to P. Chavigny, for his memoir on voluntary mutilations by firearms; honourable mentions to Léon Binet, for his work, "Le guide du médecin aux tranchées," and to André Tournade, for his work, "La pratique de l'hygiène en campagne."

Physiology.—The Montyon prize to Gabriel Foucher, for his memoir entitled "Etudes biologiques sur quelques Orthoptères"; the Lallemand prize to J. Tinel, for his work on lesions of the peripheral nerves; a very honourable mention to Stephen Chauvet, for his memoir, "Infantilisme hypophysaire"; the Pourat prize to Henri Bierry and Albert Ranc, for their work on free and combined glycose in the blood; the Philipeaux prize to Georges Stodel.

Statistics.—Montyon prizes to Henri Abraham and Paul Sacerdote (1000 francs), for the "Recueil de constantes physiques," and a mention (500 francs) to Jules Delobel, for his researches relating to the protection of infants.

History and Philosophy of the Sciences.—The Binoux prize to F. Gomes Teixeira, for his "Obras sobre mathematica," and an honourable mention to Albert Bordeaux, for his "Histoire des sciences physiques chimiques et géologiques au XIXe siècle."

Medals.—The Berthelot medal to Marius Picon and Marcel Lantenois, and to Gustave Vavon.

General Prizes.—The Grand Prize of the Physical Sciences to Emile Roubaud, for his work on pathogenic trypanosomes; the Serres prize to Jean Eugène Bataillon, for his work on experimental embryogeny; the Petit d'Ormoy prize (pure or applied mathematics) to Pierre Duhem, for the whole of his work, and especially for his memoir entitled "Le Système du monde: Histoire des doctrines cosmologiques de Platon à Copernic"; the Petit d'Ormoy prize (natural sciences) to (the late) Henry Dufet, for his work in crystallography; the Saintour prize to Henri Lebesgue, for his studies on the principles of the infinitesimal calculus; the Henri de Parville prize between Charles de la Vallée Poussin (2000 francs), for his mathematical works, D. Bois (1000 francs), for his works dealing

with the horticulture and popularisation of colonial plant products, and N. Lallié (500 francs), for his book, "Les moteurs agricoles"; the Henry Wilde prize between A. Claude (2000 francs), for his researches in astronomy and physics, and Georges Sagnac (2000 francs), for an apparatus useful in national defence; the Gustave Roux prize to Joseph Guyot, for his contributions to physics; the Thorlet prize to Adolph Richard, for his work in connection with catalogues of scientific periodicals in Paris libraries. The Lannelongue foundation is divided between Mmes. Cusco and Rück; the Trémont foundation (1000 francs) to Charles Frémont, for his researches on the working of metals; the Gegner foundation to Ferdinand Gonnard, for his work in crystallography and mineralogy; the Henri Becquerel foundation to (the late) Bernard Collin (1500 francs).

The Vaillant, Fourneyron, Pierson-Perrin, Damoiseau, Pierre Guzman, G. de Pontécoulant, Bréant, Godard, Mège Argut, Fanny Emden, Alhumbert, Lonchampt, Laplace, Rivot, and Normal School prizes were not awarded this year.

COMMITTEE ON THE CHEMICAL TRADE.

THE Committee appointed by the Minister of Reconstruction to advise as to the procedure which should be adopted for dealing with the chemical trade has now concluded its deliberations and issued its report (Cd. 8882, price 1*d.* net). The Committee was appointed (1) to advise as to the procedure which should be adopted by the Minister of Reconstruction for dealing with the chemical trade; (2) to consider and report upon any matters affecting the chemical trade which could be more effectively dealt with by the formation of special organisations for the purpose, and to make suggestions in regard to the constitution and functions of any such organisation.

The members of the Committee are:—Sir Keith W. Price (chairman), Mr. John Anderson, Mr. J. F. L. Brunner, Dr. Charles Carpenter, Prof. J. G. Lawn, Sir William Pearce, Mr. K. B. Quinan, the Right Hon. J. W. Wilson, and Mr. G. C. Smallwood (secretary). The report of the Committee is here summarised.

It is evident that during the process of reconstruction numerous difficult problems and questions are likely to arise in connection with the chemical trade. The Committee is of opinion that these can be satisfactorily settled only by the closest collaboration between the Minister of Reconstruction and the representatives of the trade, and it appears to be necessary that the Minister should be in a position to obtain the views both of the trade as a whole and, in the case of particular problems, of that branch of the trade directly concerned.

This end could probably be attained in a satisfactory manner if there were in the chemical trade a representative body, which could advise the Minister and act in a consultative capacity on chemical matters. Such a body should be fully representative of the whole of the trade, and the difficulty of the Committee lies in naming an association which could be said completely to fulfil this condition.

The Committee is of opinion that, in dealing with the chemical trade, the Minister of Reconstruction could properly act in collaboration with the Association of British Chemical Manufacturers. It is further of opinion that with a view to convenience of practical working, and in order to establish the permanent link which should exist between the Ministry and the trade in all its branches, a standing committee should be established fully representative of all the interests concerned.

As to points of reference No. 2, the opinion is expressed that whatever may be the functions of the Ministry of Reconstruction, it will be necessary to establish a section of that department which will be in a position to deal with matters which may arise in connection with the chemical trade. The appointment to the Ministry of Reconstruction of a scientific man of good standing, who would command the respect and confidence of the trade, together with the necessary staff, is suggested. This section, working in conjunction with the standing committee previously mentioned, would provide the Minister with an adequate organisation for dealing with such questions connected with the chemical trade. The following would represent some of the duties of this section:—

(1) To ascertain with the assistance of the standing committee the chief problems which are likely to arise in the process of reconstruction after the war, and the best means of dealing with them. (2) To survey generally the chemical trade, both at home and abroad, and in consultation with the standing committee to afford advice for the broadening and improvement of the chemical trade of this country. (3) To collect and disseminate information on, and statistics of, the chemical trade. (4) To collect and collate as much information as is available on the work which has been done during the present war, which would, no doubt, be of great interest and assistance to the chemical trade as a whole.

The Committee states in the report that it has confined its recommendations within the narrow limits defined by the terms of reference, which speak only of "chemical trade." If, however, for that expression were substituted "the National Chemical Industry," a much broader purview would be involved, and specific reference would be necessary to existing organisations other than those specifically founded for "trade" purposes, among which may be mentioned:—The Society of Chemical Industry, the Government Laboratory, the Committee of the Privy Council for Scientific and Industrial Research, the Imperial Institute, the National Physical Laboratory, and the Chemical Society.

Summary of Recommendations.

1. That in dealing with the problems of the chemical trade action should be taken so far as possible in the closest collaboration with representatives of the trade.

2. That the Association of British Chemical Manufacturers should be considered as representative of the chemical trade as a whole with certain branches excepted.

3. That a standing committee should be appointed. This committee, which should be fully representative of all the interests concerned, would establish a permanent link between the Ministry and the trade.

4. That a departmental organisation should be set up in the Ministry of Reconstruction to deal with chemical questions.

THE PHYSIOLOGY OF LEARNING.[1]

IN the hope of throwing fresh light on the obscure problem of what goes on when animals "learn," Mr. Joseph Peterson has tested the effect of altering the length of culs-de-sac in the mazes which white rats were asked to solve on their way to the food-box. There is no doubt that the animals can learn; the question is, What precisely happens? and it is plain that the answer is not going to be easy. Organisms are very complex creatures, and animal behaviour in

[1] "The Effect of Length of Blind Alleys on Maze Learning. An Experiment on Twenty-four White Rats." By Joseph Peterson. Behaviour Monographs, vol. iii., No. 4. Pp. 53. (1917.)

many of its expressions is extremely complex. The author has no use for psychological assumptions, such as that the rat "perceives relations," or "makes practical judgments," or "has ideas." We do not know why "it is needless to say that no evidence of ideational behaviour has been found in the white rat."

When a rat emerges from a blind alley in the maze, it may run forward or it may return on its own track. But with experience the percentage of returns rapidly decreases, especially in the case of the culs-de-sac nearer the end of the journey—the food-box. There is a progressive elimination of entrances to blind alleys, but this does not come about mainly by a decrease in the *number* of entrances, but principally, especially in the case of the longer alleys, by a gradual decrease in the *degree* or distance of entrance. "Just before entrance is eliminated completely, there frequently occurs a peculiar and very rapid vibration of the rat's head between the direction of the true path and that of the tempting blind alley." Entrances to short culs-de-sac are eliminated more readily, other things being equal, than entrances to long ones.

Many facts indicate that to a large extent the maze is learned "as a whole." There must be "some sort of short-circuiting process" by which the right path is suggested for the line of action when the animal comes to the entrance of any blind alley. "It is not clear how any of the usually accepted laws of learning —frequency, recency, and intensity—can operate to bring this about. Frequency and recency fail entirely to account for the behaviour of the rat in the maze. The real process of learning, the gradual elimination of unsuccessful random acts, such as entrances to culs-de-sac and returns towards the entrance place in the maze, must be accounted for on the basis of some entirely different principle. The principles named show only how an act, directed by some other factor, becomes gradually more mechanically reflex."

What, then, is the author's theory? He calls it the "completeness of response" principle in learning. "Responses to stimuli cannot take place instantaneously, neither do stimulation effects fade away momentarily. Besides this, response tendencies and muscular strains, maintained for a shorter or longer time, constantly set up new sensory impulses (proprioceptive stimuli), which again stimulate reactions." By such means the effects of successive stimuli, such as the rat encounters in the maze, come to operate in a measure simultaneously, and the resulting response is on the whole the most consistent or complete that can be given in the whole circumstance. "The channels to this most complete response are gradually forced most open or permeable; their greater consistency of operation (facilitation) brings about an intensity of activity through them, which in repeated trials gradually short-circuits through the infinitely numerous pathways involved, and thus brings about the gradual elimination of useless random acts." This is not exactly luminous; the author's theory is only tentative.

It is suggested that learning comes about by this means, and that theories of the "stamping-in of the effects of pleasantness" or of the direction of the animal by conscious states must be laid on the shelf. It can scarcely be said, however, that Mr. Peterson's new theory has yet reached a high degree of lucidity, and there seems to us a smack of dogmatism in the brushing aside of unfashionable ideational interpretations. But the conception of the overlapping of effects of successive nerve functionings is very interesting, and we shall look forward to hearing more of it—especially as a suggested interpretation of the results of ingeniously contrived and punctiliously controlled experiments.

INTERNATIONAL FISHERY STATISTICS.[1]

THE publication of the eighth Annual Statistical Bulletin of the International Council for Fishery Investigations is of interest from the point of view of questions of post-war reconstruction. When the council began its work in 1902 it was decided that an annual summary of the commercial fishery statistics of the maritime countries of northern Europe should be compiled. Probably no one except those actually engaged in this task of compilation has ever really appreciated the difficulties of this work. There is no uniformity in the methods of collection of fishery statistics in the countries participating in the schemes of investigation; the ideals of detail and accuracy have always been very different, and official custom and tradition have made it exceedingly difficult to modify or change the methods. To all this we must add international susceptibilities; thus some of the official reports of the International Council are framed in diplomatic style and published in French, but the *Bulletin Statistique* is presented to the public in a queer mixture of English and German. Much of the matter, explanations, discussions, headings, descriptions of tables, and so on, are given in duplicate—an irritating and wasteful compromise.

There has always been (an evidently inevitable) delay in publication; thus the first bulletin, which appeared in 1906, dealt with the statistics of 1903–4, while this last one, published in 1917, summarises the data for 1911–12. The figures for the various fisheries are admittedly estimates and are rounded off, and there are, apparently, no means of arriving at any notions of the magnitudes of the errors involved. The whole treatment is very general and detail is minimal. Now, with all these defects the bulletins have achieved very much, how much anyone may attempt to estimate by trying to think of any other international industry for which we have even an approximation to the knowledge which we possess with regard to European fisheries. The defects of the bulletins are necessarily those of the national systems of fishery statistics, which are the sources of information. In May of 1914 the council began to consider changes, both with regard to arrangement and matter, and the possibilities of speedier publication. Then followed the events of the last three years, postponing indefinitely this task of reconstruction.

Apart from the improvement of the national statistical systems, any improvement of the International Bulletin would have been of little significance. Now the hiatus in fishery investigation that has existed since August of 1914 simplifies the task of reconstruction; there has been a break of continuity which really invites "scrapping" on a large scale. Nowadays there is so much uniformity in general methods of fishing and in commercial methods of distribution that there is scarcely any excuse for diversity of treatment with regard to statistics; given the will to improve and there need be no real difficulty in remodelling official methods. In almost all the national systems (the reports of the Fishery Board for Scotland are perhaps the only exception) there is an irritating and fatal absence of detail. Pedantic accuracy is unnecessary, even if it were attainable, but every local fishery should somewhere or other be recorded; as it is, generalised statements only are accessible. It is the continual experience of everyone who attempts to make use of official fishery statistics that the data are inadequate, or ambiguous, or misleading. All this imperfection must necessarily be reflected in the data of the international *Bulletin Statistique*, and rearrangement of the matter of the latter would only go a little way towards the reconstruction that is so desirable.

J. J.

1 "Bu'letin Statistique des Pêches maritimes des pays du Nord de 'Europe." Vol. viii., pour les années 1911–12. Edited by Prof. D'Arcy W. Th[illegible]

THE PRODUCTION OF SCIENTIFIC KNOWLEDGE.[1]

THE increase of scientific knowledge can be divided into three steps: first, the production of new knowledge by means of laboratory research; secondly, the publication of this knowledge in the form of papers and abstracts of papers; thirdly, the digestion of the new knowledge and its absorption into the general mass of information by critical comparison with other experiments on the same or similar subjects. The whole process, in fact, may be likened to the process of thought. We have first the perception by means of the senses. The percept is then stored in the memory, and in the mind is compared with other previously stored percepts, and finally forms with them a conception.

I desire in this paper to consider the methods by which these three sections of the production of knowledge may be carried on, to suggest an arrangement of laboratories to produce experimental results dealing with any branch of science, then to consider how the knowledge so obtained may best be stored and classified, and, finally, the methods to be employed to make the results of scientific research available for application.

(1) *Research Work.*

The agencies engaged in scientific research are of several kinds. The traditional home of research work is in the university, and the bulk of the scientific production of the world comes from institutions connected with teaching. The industries are more and more supporting research laboratories, a large number of which contribute to the general fund of scientific knowledge by publishing the results which they obtain, and some of which are engaged upon purely scientific work of no mean order. Consulting and technical laboratories engaged in industrial work make frequent contributions to science, and there are some very important laboratories engaged in pure research work which are supported by philanthropic foundations.

The classification of research laboratories is not altogether an easy task. They may obviously be classified according to the source of the funds which support them—that is, we may classify them as university laboratories, industrial laboratories, Government laboratories, institution laboratories, and so on—but if we look at them simply in the light of the research undertaken, this does not seem to be altogether a logical classification, since there is little distinction between the work done in some university laboratories and some industrial laboratories, and the work of the Government and institution laboratories again overlaps that of the two former classes.

The University of Pittsburg, for instance, has an industrial laboratory, where definitely technical problems are dealt with. The research work on photometry done at Nela Park and at Cornell University would seem to be similar in kind, and work on physical chemistry or on the structure of chemical compounds is of the same type, requires the same class of workers, and produces the same results, whether it be done in a university, in a laboratory of the Carnegie Institution, or in such an industrial laboratory as that of the General Electric Co. It is equally difficult to classify laboratories according to the purpose for which researches are avowedly carried on. Most university laboratories are willing to undertake work of industrial value, and, indeed, some specialise in such problems, while many industrial laboratories are quite willing to carry out a research of purely academic and theoretical interest provided the problems involved bear a relation to the general work of the laboratory.

[1] From a paper read before the Rochester Section of the Optical Society of America on October 23, by Dr. C. E. Kenneth Mees.

A useful classification of laboratories can, however, be obtained if we consider whether the problems investigated in a laboratory are all connected with one common subject or whether the problems are of many kinds, having no connecting bond of interest. I would suggest that the first type of laboratory might be called "convergent" laboratories, and the second "divergent."

In the "divergent" group of laboratories are included all those institutions where research is carried on which are interested in science in general or in science as applied to industry, and will attack any problem that may seem to promise progress in knowledge or, in the case of an industrial laboratory, financial return. Most university laboratories are of this type. When they devote themselves to special problems it is usually because of the predilection of some professor, and as a general rule a student or instructor may choose any problem in the whole field of the science in which he is working and may carry out an investigation on that problem if he be interested in it without regard to the relation of his work to the other work which is carried on in the same laboratory.

Correspondingly, in most industrial laboratories the problems investigated are those which present themselves as a result of factory experiences or of suggestions from the men working in the laboratory, and promise financial return, and the different problems carried on in the same laboratory are not necessarily related in any way whatever.

The greater number of university and industrial laboratories are necessarily of this type. It would be a disadvantage for a university laboratory, the primary business of which is training students, to be too narrowly specialised. Specialised university laboratories are desirable only in the case of post-graduate students, and it would be very inadvisable to allow the laboratories responsible for the general training of scientific men to specialise in one branch of science, since as a result the students would acquire a proper acquaintance with only a limited portion of their subject.

Industrial laboratories, on the other hand, must necessarily be prepared to deal with any problems presented by the works, and as these will be of all kinds, covering generally the whole field of physics, chemistry, and engineering, it is impossible for the usual works laboratory to specialise except in so far as it deals with the works processes themselves.

In the "convergent" laboratories, however, although the actual investigations may cover as great a range of science as those undertaken in a "divergent" laboratory, yet all those investigations are directed towards a common end—that is, towards the elucidation of associated problems related to one subject. Thus, the staff of the Geophysical Laboratory, which includes physicists, geologists, crystallographers, mineralogists, and chemists, works on the structure of the rocks, and although the field of the actual investigations ranges from high-temperature photometry to the physical chemistry of the phase rule, yet the results of all the work carried out are converged on the problem of the structure of the earth's crust.

The Nela Park Laboratory, in the same way, is studying the production, distribution, and measurement of illumination, and all its work, which may involve physiology, physics, and chemistry, is related to that one subject. Such convergent laboratories sometimes develop in universities owing to the intense interest of a professor in a single subject and to the enthusiasm which inspires students and assistants to collaborate with him and to concentrate all their energies on the same group of problems. There are many examples of such laboratories, such as the laboratories dealing with radio-activity, and those which are concerned chiefly

with spectroscopy. Among others may be mentioned the Cavendish Laboratory at Cambridge and several of the larger university laboratories which deal with the physical chemistry of solutions.

But these university laboratories are rarely able to concentrate on to the group of problems which they are studying specialists from such different branches of science as are available for similar laboratories outside the universities owing to the fact that it is very difficult to obtain interdepartmental co-operation in research in a university. In a specialised laboratory, on the other hand, workers in all branches of science may well collaborate in the investigation of problems representing different points of view of one general subject.

In addition to the examples of industrial and institutional laboratories mentioned above I should like to illustrate the structure of a convergent laboratory, if I may be forgiven for doing so, by referring to the organisation of the research laboratory with which I am connected—that of the Eastman Kodak Co.

The purpose of this laboratory is the investigation of the scientific foundations of photography and its applications, everything relating to photography in all its branches and applications being of interest. The branches of science which are of chief importance in photographic problems are those of optics in physics and of the colloidal, physical, and organic branches of chemistry, and the relations of these sciences to photographic problems are shown in graphic form in Fig. 1.

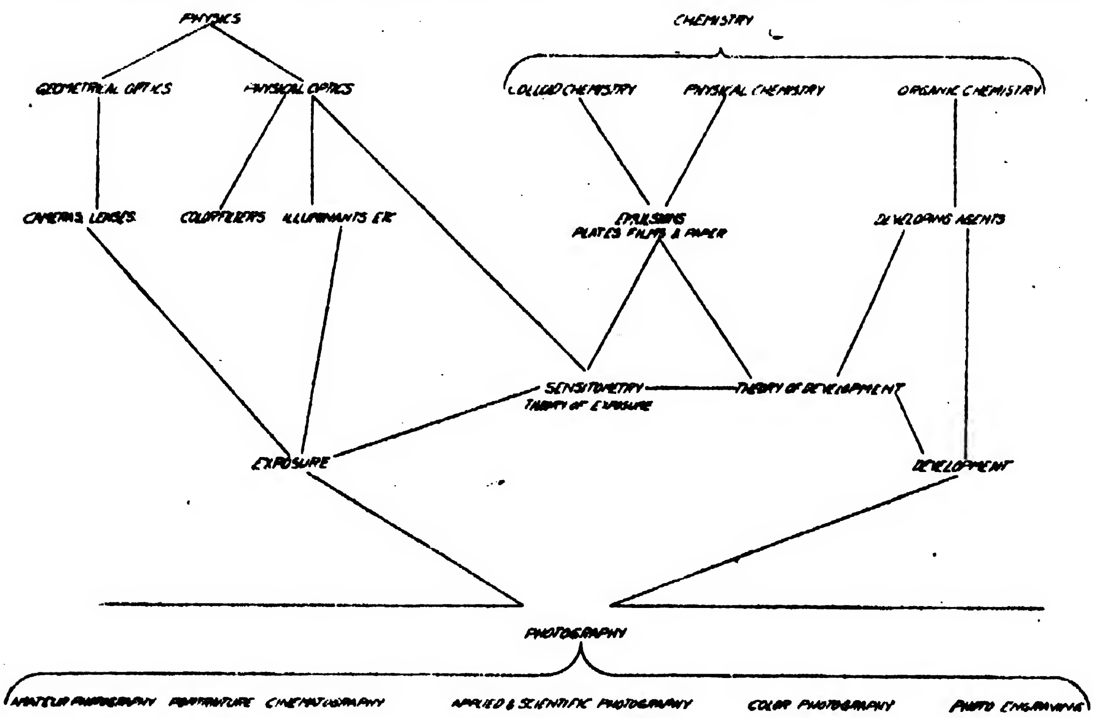

FIG. 1.

Optics deals on its geometrical side with the materials used in photography—cameras, lenses, shutters, etc.—and on its physical side with such materials as colour filters and illuminants, but especially with the study of the relation of the photographic image to the light by means of which it was produced—a study which is known by the name of sensitometry. The manufacture of the sensitive material itself, which on modern photographic plates, films, and paper is called the emulsion, is a province of colloid and physical chemistry, colloid chemistry dealing with the precipitation and nature of the sensitive silver salts formed in their gelatine layer, while physical chemistry informs us as to the nature of the reactions which go on, both in the formation of the sensitive substance and in its subsequent development after exposure.

The organic chemist prepares the reducing agents required for development and the dyes by which colour sensitiveness is given to the photographic materials and by which the art of colour photography can be carried on, and while the physicist therefore deals with sensitometry and the theory of exposure, the chemist must deal at the same time with the theory of development and with the conditions relating to the development of photographic images.

A laboratory, therefore, for the study of photographic problems must be arranged with a number of sections, such as are shown in Fig. 2. In physics we require departments dealing with sensitometry and with illumination, reflection and absorption, colorimetry, spectroscopy, and geometrical optics. We need a department of colloid chemistry, one of physical chemistry, one of organic chemistry, one of photo-chemistry to deal with the action of light upon the plate, and, finally, a number of photographic departments dealing with photographic chemistry, with portraiture, colour photography, photo-engraving, motion picture work, and X-ray work, and all these departments are converged together first upon the theory, and then upon the practice, of photography.

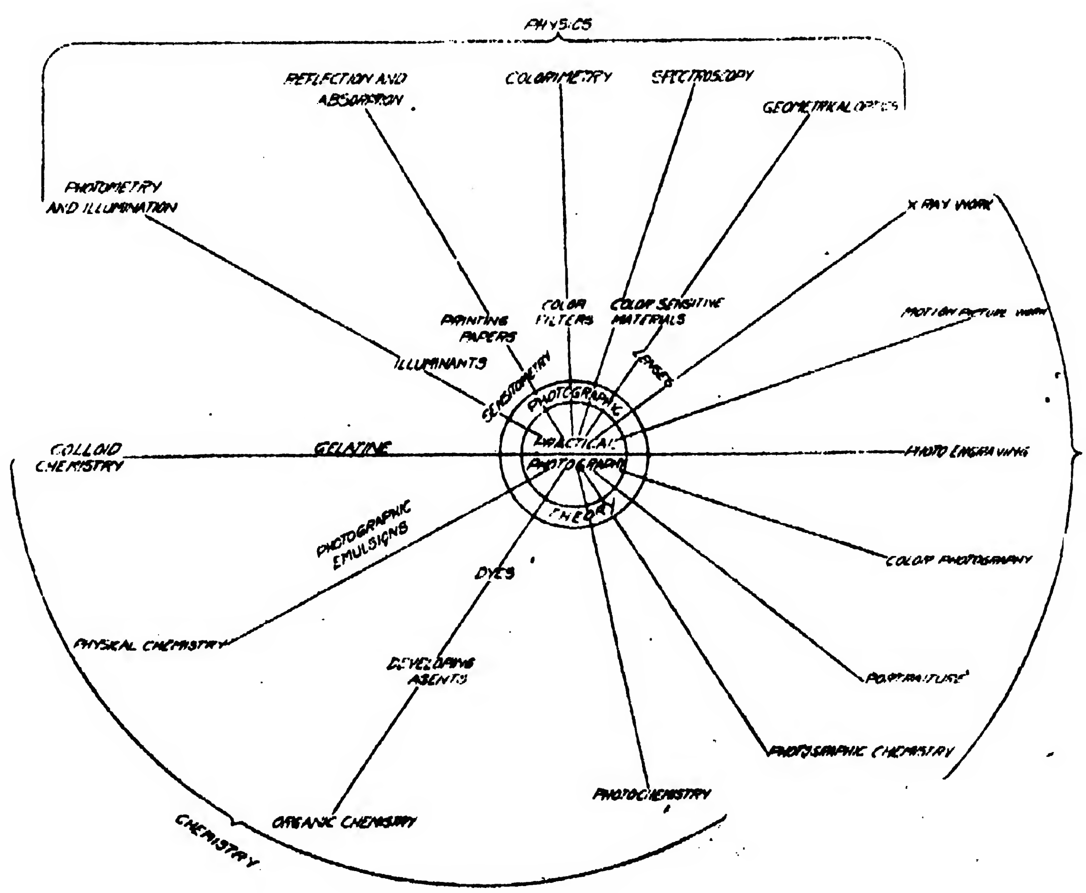

FIG. 2.

Each research specialist in the laboratory is given

work corresponding with a limited field of science, so that while his special attention is devoted to that one department his field of activity just overlaps that of the departments on each side of him, while his general knowledge of the subject should, of course, cover a much wider range. It is important that each man should have his own special field of work, and that overlapping should not be complete, since such complete overlapping will inevitably produce friction destructive of co-operation and harmony. The way in which such a subdivision is arranged may perhaps be best illustrated by Fig. 3, which shows the range of the specific investigations of those who in our laboratory cover the range of research work between sensitometry and pure physical chemistry. There are five workers in this range; the first, A, being a pure physicist, B a physicist with a considerable experience of chemistry, C a physical chemist who is specialised in photography, D a physical chemist who is specialised in photographic theory, and E a pure physical chemist. The interest of each of these workers overlaps the field of the other workers, but nevertheless each of them has his own specific problem, his own equipment and apparatus. Thus, A and B use sensitometric apparatus chiefly, C both sensitometric apparatus and the thermostatic and electrical equipment of physical chemistry, D microscopic apparatus and chemical apparatus dealing with the precipitation of silver salts, and E the analytical and solubility apparatus of chemistry.

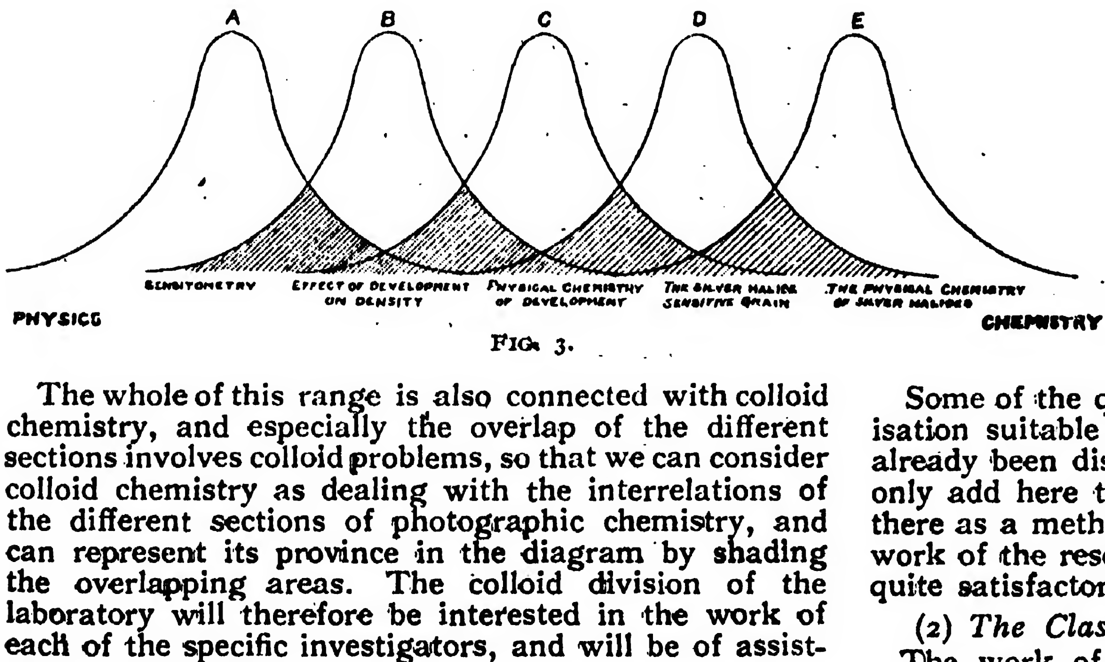

FIG. 3.

The whole of this range is also connected with colloid chemistry, and especially the overlap of the different sections involves colloid problems, so that we can consider colloid chemistry as dealing with the interrelations of the different sections of photographic chemistry, and can represent its province in the diagram by shading the overlapping areas. The colloid division of the laboratory will therefore be interested in the work of each of the specific investigators, and will be of assistance to all of them.

These charts, prepared for a photographic laboratory, are equally applicable in form for almost any other convergent laboratory, so that if we have to work out the organisation of a research laboratory which is to study any interrelated group of problems, we can do it by the construction of charts similar to these. Thus, considering Fig. 1, we place first at the bottom of the chart the general subject considered and its various branches, and then above these the scientific problems involved, separating out on opposite sides of the chart those problems which would involve different branches of pure science. Thus, we can place on one side biological problems, then physical problems, then chemical problems, and so on, so reconstructing a chart similar to Fig. 1 from the bottom up, until at the top we have the various branches of pure science involved, subdividing these branches until each subdivision represents the work capable of being handled by one man in the laboratory.

It will now be possible to draw Fig. 2, showing on the circumference the different sections of the laboratory for which accommodation, apparatus, and men must be provided, and showing the relation of these sections to the problem as a whole, and having worked this out, it is easy to find the amount of space and the number of men which will be required or which the funds available will allow for each part of the work.

Specialised laboratories may originate in various ways, but it seems clear that with an increasing total amount of research and with an increasing realisation of the importance of research more laboratories will be developed, and no doubt laboratories which originally were of the divergent type will with their growth tend to split into a linked group of convergent laboratories. Consider, for instance, a very large industrial research laboratory covering a wide field of research and dealing with many different types of problems. There are two types of organisation possible to such a laboratory. It might be divided according to the branches of science in which the workers were proficient. It might have, for instance, chemical divisions, physical divisions, and so on, but if the groups of problems dealt with were reasonably permanent in their character it would more probably develop into a group of convergent laboratories in which men from different branches of science—chemists, physicists, and so on—worked together (and probably even had their working places in proximity) because they were working on the same general problem. Any national laboratory which is developed for industrial research, for instance, should almost certainly be organised as a group of convergent laboratories rather than as a group of separate physical, chemical, engineering, etc., laboratories.

We may expect, then, that the general organisation of scientific research will tend towards the production of numbers of specialised laboratories, each of which will be working on an interrelated group of problems, and attacking it from various points of view.

Some of the questions relating to the internal organisation suitable for these convergent laboratories have already been discussed in a former paper,[2] and I need only add here that the "conference" system described there as a method of actually carrying on the scientific work of the research laboratory has continued to prove quite satisfactory.

(2) *The Classification of Scientific Knowledge.*

The work of the research laboratories is published by various methods in the form of scientific papers, and with the increasing amount of research done the number of technical journals is increasing steadily, so that the workers in most branches of science find it difficult to keep up adequately with the current literature, and especially those who become interested in the light thrown upon their own problem by other branches of science find it a task of great magnitude to acquaint themselves adequately with the literature. In order to meet this difficulty the various scientific societies publish journals giving abstracts in a conveniently indexed form of all the important papers published, and these abstract journals are of great value in searching for information on special subjects.

In spite of these abstract journals the task of obtaining all the references to the literature on a given subject is still a formidable one, and might be very much simplified by the adoption of some radical changes in the organisation of the abstraction and classification of scientific knowledge. In the first

2 "The Organisation of Industrial Scientific Research," *Science*, 1916 p. 763. NATURE, 1916 pp. 411 and 431.

place, there seems to be no reason why abstracts of scientific papers should be prepared by the national societies. At present, for instance, there are at least four complete sets of abstracts of chemical papers prepared in different countries, together with a number of less complete sets, and this represents a great overlapping and duplication of effort. Secondly, sciences which have not so many or such wealthy workers as chemistry cannot afford to produce any complete abstract journals, so that in these sciences reference to the literature is much more difficult. There seems to be no reason why an interchange of abstracts between different countries could not be arranged, and, indeed, it might be the best method of obtaining abstracts to have the author of a paper supply an abstract suitable in form and length for the abstract journal at the same time that he sends his paper to the journal which publishes it.

(3) *The Utilisation of Scientific Knowledge.*

The actual application of science to industry is so vast a subject that it cannot be considered here, but it is not satisfactory to leave the results of research at the point where they are published in papers and filed in the abstract journals. In order to make them available as a part of scientific knowledge the new information as it is obtained must be incorporated in books.

There are three classes of books dealing with scientific work, which require separate consideration. The first class comprises the dictionaries, in which almost all the progress in some branches of science can conveniently be summarised. Beilstein's "Dictionary of Organic Chemistry" is a good example of the way in which almost all the facts of a science can be absorbed in a classified form and made available for ready reference. These dictionaries, in fact, represent the critical and discriminating summary of the scientific publications on the subjects with which they deal, and the preparation of such dictionaries should be ensured by international co-operation of the national societies.

Other sciences, however, do not by their nature lend themselves to the convenient preparation of dictionaries, and what is wanted in this case are critical and well-arranged handbooks covering the whole science, and resuming impartially, but critically, the various additions which are made from time to time in the different branches of the subject. These handbooks, as well as the dictionaries, would, of course, require the addition of supplementary volumes from time to time, and occasional complete revision.

The preparation of both dictionaries and handbooks would, of course, be greatly facilitated by the existence of a numerically classified card index to the literature concerned, and the preparation and revision of such books might well be undertaken in connection with the large libraries having in their possession the complete classified card indexes.

On the other hand, for the assistance of advanced students of science, what is required is a steady supply of monographs correlating critically and comprehensively all the literature in a special field, and these must be brought up to date from time to time. Such monographs are especially required in connection with rapidly developing new branches of science; it is difficult to over-estimate the importance and value for progress in research of such a book as Bragg's "X-rays and Crystal Structure," for instance, and while nothing should be done to hinder individual initiative in publishing such books, it would seem that when it was apparent that some branch of science required such a monograph a national society might very well approach well-known workers in the field and request them to write such a book, offering its assistance in the matter of bibliography, and also offering to arrange for the publication of the manuscript.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Science Museum, South Kensington, was reopened to the public on Tuesday, January 1. The museum has been closed to the public for nearly two years; it has, however, been open without interruption for students. As compared with 1914 conditions, the extent and the hours of opening for 1918 are somewhat reduced, but the greater part of the museum will be open free on every weekday from 10 a.m. to 5 p.m., and on Sundays from 2.30 p.m. to 5 p.m. The collections contain many unique objects of great interest as representing discoveries, inventions, and appliances that have been of first-rate importance in the advancement of science and of industry. Such objects as Watt's engines, early locomotives, steamships, flying machines, reaping machines, and textile machinery are records of British contributions to the progress of the world; and it is gratifying that these can again be made available for inspection by visitors to London from all parts of the United Kingdom and from distant parts of the Empire.

A COPY of the calendar for the session 1917–18 of the University of Sheffield has been received. In addition to the courses of study arranged for students preparing for graduation in the ordinary university faculties, many other departments, designed to meet the more special needs of the area served by the University, have been inaugurated. Among these may be mentioned the two years' course of work in the University and the Sheffield Training College of Domestic Science; lectures on welfare work for men and women; and an extensive system of University extension work. The departments of applied science are intimately associated with local industries. The faculty of engineering, for instance, includes departments of mechanical, electrical, civil, mining, and chemical engineering, applied chemistry, building, and glass technology. The faculty of metallurgy is concerned with ferrous and non-ferrous metallurgy. The diplomas and certificates of the University are recognised as exempting from examinations for admission to many professional institutions; and the University has, also, been recognised by the Home Office as an approved institution for the examination of mine surveyors. A research delegacy in glass technology, consisting partly of members of the University and partly of representatives of the glass industry, has been instituted. The aims of the delegacy are to promote research in glass technology and to provide for the teaching and training of students in this subject.

AN interesting account was published in the *Times* of December 29 of "Khaki College," a school of civil learning which has been inaugurated in a division of the Canadian Army stationed at Witley Camp in Surrey. Khaki College is the expression of the spirit and ideal of a young and vigorous Oversea nation; and its most important aim is to help young soldiers, whose studies may have been interrupted by the war, still to equip themselves for the return to civil life. At a camp there is little for the men to do in the evenings, and those responsible for providing healthy recreation for the Canadian soldiers organised regular meetings of men under a tree in the "Pine Grove" to discuss questions of academic interest, and to listen to lectures by officers in command. Soon a demand arose for regular classes, and the would-be students were so many that the authorities of the Canadian Army decided to organise Khaki College. The teaching staffs are recruited from within the Canadian Army, and consist of university professors and others. The courses of lectures cover classics, history, modern languages and literatures, mathematics and engineer-

ing, business and agriculture; and the Senate is prepared to establish classes, in any subject whatever, for which there is sufficient demand. Students from the Canadian universities serving in the Army will have their Khaki College work "credited" on the return. When demobilisation sets in, some time must elapse before the Canadian soldiers then in England can be repatriated; Khaki College, while equipping men for their return to civil life, will prevent them from degenerating into vicious habits of idleness apt to ensue from a prolonged life in the base camps. It is this aspect of the movement which first appealed to the High Canadian Command, and it is to anticipate the problems of the period of demobilisation that the High Command has encouraged the establishment at the front of the University of Vimy Ridge. That institution is, indeed, established on a basis quite as elaborate as the institution at Witley. Some idea of the scope of its work is afforded by the long list of lectures on history and economics, applied science, languages and literature, agriculture, and business. At Witley there are 200 studying scientific agriculture, and 200 taking the business course. There are 150 students of history, 125 of English, 75 of the classics, 100 of French, 50 of mathematics, and smaller numbers in other courses.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, December 12, 1917.—Mr. E. Heron-Allen, president, in the chair.—W. **Bateson**: Cytology and genetics. Attempts to find regularity in the distribution of chromosome numbers had generally been unsuccessful, but attention was directed to the recent work of Winge, who, by preparing a graph of these numbers in plants, had shown that simple multiples of 2 and 3 occur with special frequency, while prime numbers are rare and exceptional. A survey was given of the phenomena of linkage between genetic factors as demonstrated in breeding experiments, with a discussion of Morgan's suggestion that this linkage is due to a linear arrangement of the linked factors in the same chromosome. Whether the proposition in its entirety was established or not might be doubtful, but the factors certainly behaved as if arranged in lines, and, as represented by the theory, a great diversity of genetic and cytological observations relating to the heredity of sex and other characters assumed an orderly form.—G. S. **West**: A new species of Gongrosira. A lime-encrusted alga, forming somewhat nodular masses 4–9 mm. thick, of a vivid green colour, was found at Westen Mouth, Devon, growing in such a position that it received the full force of a stream of water falling about 2 ft. It proved to be new, and is described as *G. scourfieldii*.

Aristotelian Society, December 17, 1917.—Dr. H. Wildon Carr, president, in the chair.—Dr. G. E. **Moore**: The conception of reality. Bradley asserts both (i) "Time is not real," and (ii) "Time exists, is a fact, and is"; and he evidently thinks that these two assertions are compatible. In truth, however, (i) ought to include, as part of its meaning, "There are no temporal facts," while (ii) ought to include, as part of its meaning, "There are some temporal facts"; so that the two assertions are not compatible. It is suggested that the reason why Bradley supposes them to be compatible is because he sees (*a*), what is true, that "Temporal facts are unreal" is compatible with "We think of temporal facts," and supposes also (*b*), what is false, that "There are no temporal facts" is compatible with "We think of temporal facts." If (*a*) and (*b*) are both true, it would follow that "Temporal facts are unreal" could not include as part of its meaning "There are no temporal facts"; and that hence (i) must be compatible with "There are some temporal facts." In truth, however, there is no difficulty in supposing that (*b*) is false.

EDINBURGH.

Royal Society, December 3, 1917.—Dr. Horne, president, in the chair.—Principal A. P. **Laurie** and A. **King**: Note on the hydrolysis of acid sodium sulphate. These experiments were carried out with the view of throwing light on a practical problem arising in the manufacture of explosives, and are an investigation of the effects of cooling solutions of acid sodium sulphate of various strengths, showing the laws governing the separation of the normal salt.—Dr. W. Wright **Wilson**: The absence of a nucleus in crystals of uric acid. It was suggested that the lack of a nucleus might be hereditarily connected with abnormal conditions.—A. M. **Williams**: The thermodynamics of adsorption. This thermodynamic investigation into heat effects accompanying adsorption led to expressions for three isothermal heats of adsorption of a gas and for the heat of immersion of a powder in a liquid. The effect of the variation of the surface of an adsorbent when adsorbing was examined, and it was shown from Titoff's observations that the divergence between calculated and observed values of the heat of adsorption could be explained on the assumption of a change of surface area. The fractional change of surface per c.c. adsorbed could be calculated, and also the surface energy per gram adsorbent *in vacuo*.—R. K. S. **Lim**: Experiments on the respiratory organs of the shore-crab (*Carcinus maenas*). The following facts were established. The direction of the respiratory current in the shore-crab is from behind forwards, whether the animal is lying above sand or buried in it. Occasionally this direction is reversed. Sea-water is sucked in beneath the carapace through four separate spaces which communicate with corresponding spaces between the gill origins. The direction of these inlets is such that the current in the gill chambers tends to travel forwards and inwards. The gills being radially arranged, and being placed across the path of the current, forces it to pass through the individual gill lamellæ, thus thoroughly bathing their surfaces.

PARIS.

Academy of Sciences, December 3, 1917.—M. Paul Painlevé in the chair.—E. **Picard**: A functional equation occurring in the theory of the distribution of electricity according to Neumann's law.—M. Vito Volterra was elected foreign associate in the place of the late M. Hittorf.—W. **de Tannenberg**: A question of indeterminate analysis.—J. **Bosler**: Meteorites and terrestrial eccentricity.—C. **Matignon** and F. **Meyer**: Monovariant equilibria in the ternary system, water, sodium sulphate, ammonium sulphate. An account of experiments undertaken to supply a rational solution of t[he] problem of the preparation of ammonium sulphate from sodium bisulphate.—E. **Hildt**: New fractionating apparatus for petrol and other volatile products. The vapours are passed through a series of six Vigreux columns heated externally by the vapour of a petrol boiling between two well-defined temperatures. The vapour uncondensed by the first column passes on to a second column similarly vapour-jacketed with a lower boiling liquid. The apparatus figured shows six such columns in use, giving fractions $>150°$, $130°–150°$, $110°–130°$, $90°–110°$, $70°–90°$, $50°–70°$, $<50°$ C. Among the advantages claimed is the elimination of errors due to currents of air and to changes in the barometric pressure.—J. **Laborde**: A new method for the separation and estimation of lactic, succinic, and malic acids in wine. The method is based on the differences in

solubility of the calcium salts of the three acids in alcohol of varying concentration.—F. L. **Navarro**: The non-existence of the Cretacean in the island of Hierro (Canaries). The author, after visits to the island of Hierro in 1911 and 1917, has definitely proved the absence of Cretaceous deposits. The fossil, *Discoidea pulvinata*, described by J. Cottreau and P. Lemoine in 1910, was probably brought to the island by a ship as ballast.—F. **Georgévitch**: The evolutive cycle of *Myxidium gadii*.—A. **Lécaillon**: Aptitude for natural parthenogenesis considered in various races or varieties of the silkworm.—L. **Boutan**: The *rôle* of the fins in teleostean fishes with swimming bladder.—W. **Kopaczewski**: The mechanism of the toxic action of the serum of the muræna.

CAPE TOWN.

Royal Society of South Africa, October 17, 1917.—Dr. A. Jasper Anderson, vice-president, in the chair.—J. **Moir**: Spectrum phenomena in the chromium compounds, being part iv. of the spectrum of the ruby and emerald. It has been found that although aqueous solutions of the chromium salts do not show any narrow characteristic bands in the spectrum, yet when anhydrous (or nearly anhydrous) solutions are used the spectrum is crossed by narrow bands in the red similar to what are seen in the ruby or emerald spectrum. The solutions of chromium oxide in concentrated sulphuric and in fused metaphosphoric acid have been investigated, and the bands measured; they are very similar to those seen in the emerald, but not absolutely identical; while the bands of the ruby, although similar in arrangement, are displaced into a region of lower frequency. Both gem colours are due to chromium, but the vibrations are differently loaded (silica and beryllia against alumina).—J. **Moir**: Colour and chemical constitution Part iii.: Derivatives of the unknown ortho-para-phenolphthalein. Phthaleins in which one of the hydroxyl groups is ortho- and the other para- to the central carbon have been prepared from para-substituted phenols with oxybenzoylbenzoic acid. They are like the common phthaleins, but their absorption bands are broad, although in much the same position.

BOOKS RECEIVED.

The University of Sheffield. Calendar for the Session 1917–18. Pp. 767. (Sheffield: The University.)

Medicinsk—Historiske Smaaskrifter. 18. Om Lægekunst Hos Perserne. By A. Christensen. (København: Vilhelm Trydes Forlag.)

The Education of Engineers. By H. G. Taylor. Pp. vii+64. (London: G. Bell and Sons, Ltd.) 2s. net.

Chemistry for Beginners. By C. T. Kingzett. Second edition. Pp. viii+150. (London: Baillière, Tindall, and Cox.) 2s. 6d. net.

Les Universités et la Vie Scientifique aux Etats-Unis. By Prof. M. Caullery. (Paris: A. Colin.) 3.50 francs.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 3.

ROYAL INSTITUTION, at 3.—Electricity as an Illuminator and Doctor: Prof. J. A. Fleming.

CHILD STUDY ASSOCIATION, at 5.30.—*Discussion:* The Education of the Clever Child: Openers: G. F. Daniell and Miss M. Berryman.

ASSOCIATION OF SCIENCE TEACHERS (University College, Gower Street), at 11.30.—Some Applications of Physics: Prof. Dovidge.—At 2.30.—*Discussion:* The Teaching of Physics in Girls' Schools: Opener: Prof. F. Womack.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION, at 3.—Electric Dynamos, Motors, Transformers, and Railways: Prof. J. A. Fleming.

GEOGRAPHICAL ASSOCIATION, at 11.30.—The Crafts of Britain, Past and Future: H. Wilson.—At 3.—Map Study in Geography and Military Education: W. E. Whitehouse.

MONDAY, JANUARY 7.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Toxicity of Methyl Alcohol in Relation to its Industrial Uses. A Review of the Published Data: T. D. Morson.—The Rapid Estimation of Pyridine in Ammonia: T. F. Harvey and C. F. Sparks.—(1) Corrosion of Lead Roofing; (2) The Action of Rainwater on a Portland Stone: Prof. J. S. S. Brame.

GEOGRAPHICAL ASSOCIATION (London Day Training College), at 10.30.—*Discussion:* Geography in Advanced Courses: Openers: Miss Odell, L. Brooks, and W. H. Barker.—At 5 (King's College).—Presidential address: The Great Goddess Mother Earth: Sir W. M. Ramsay.

ARISTOTELIAN SOCIETY, at 8.—Is there a Mathematics of Intensity?: Prof. J. A. Smith.

ROYAL GEOGRAPHICAL SOCIETY (Kensington Town Hall), at 3.30.—The Yukon since the Trail of '98: Mrs. George Black.

TUESDAY, JANUARY 8.

ASSOCIATION OF PUBLIC SCHOOL SCIENCE MASTERS (City of London School), at 12.15.—President's address: The Needs of our Education at the Present Day, with Special Reference to Science Teaching.—At 3.—*Discussion:* Compulsory Science in University Entrance Examinations: Opener: O. H. Latter.—At 3.45.—*Discussion:* Examination or Inspection as a Test of Science Teaching: Opener: G. F. Daniell.—At 5.15.—*Discussion:* Subsidiary Subjects in University Scholarship Examinations: Opener: H. de Havilland.

ROYAL INSTITUTION, at 3.—Electric Telegraphs and Telephones: Prof. J. A. Fleming.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—A Statement in Commemoration of the Founding of the Institution on January 2, 1818.—Rail-Creep: F. Reeves.—Creep of Rails: H. P. Miles.

WEDNESDAY, JANUARY 9.

ASSOCIATION OF PUBLIC SCHOOL SCIENCE MASTERS (City of London School), at 11.—*Discussion:* "Descriptive Astronomy" in the "Science for All" Course: Openers: Rev. A. L. Cortie, S.J., E. O. Tancock.—At 12.—*Discussion:* "Map Work" in Schools.

MATHEMATICAL ASSOCIATION (London Day Training College), at 5.30.—The Graphical Treatment of Power Series: Dr. W. P. Milne.

GEOLOGICAL SOCIETY, at 5.30.—The Highest Silurian Rocks of the Clun Forest District (Shropshire): L. D. Stamp.

THURSDAY, JANUARY 10.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Electrical Signalling and Control on Railways: C. M. Jacobs.

MATHEMATICAL ASSOCIATION (London Day Training College), at 11.—The Uses and Functions of a School Mathematical Library: Dr. W. P. Milne.—Nomography: Dr. S. Brodetsky.—Some Suggestions for a Presentment of Mathematics in Closer Touch with Reality: G. Goodwill.—At 2.30.—President's address: Mathematics and Individuality: Prof. T. P. Nunn.—*Discussion:* The Position of Mathematics in the New Scheme of the Board of Education for Secondary Schools: Openers: W. D. Eggar, P. Abbott, Miss J. Dow.

FRIDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY (Kensington Town Hall), at 3.30.—The Old Life in Egypt: Miss Mary Brodrick.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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CHINSURA.

THURSDAY, JANUARY 10, 1918.

GERMAN COMMERCIALISM AND THE WAR.

My Four Years in Germany. By J. W. Gerard. Pp. xiv + 320. (London: Hodder and Stoughton, 1917.) Price 7*s.* 6*d.* net.

IT has been an invariable characteristic of all the wars upon which Germany has embarked since the attack on Denmark in 1864 that the real motives of her rulers have been sedulously concealed from the mass of the people. She has in all cases sought to fix the cause upon her opponents and to throw upon them the obloquy of breaking the peace. This, of course, is an obvious trick, and no doubt has its advantages in the case of a nation which is not allowed to think for itself, and for whom opinion is manufactured through the agency of a controlled Press. But the rest of the world has never been deceived, and the true nature and motives of the quarrel have been understood and appreciated at their real merit. In every instance, as in the present case, Germany has been the actual aggressor, and in all her motive has simply been self-aggrandisement. Her action has been primarily directed by an autocracy which rests upon two powers—the one an aristocracy that regards war as a virtue and a necessity; the other capitalism, which speculates on war as a means to gain wealth and commercial influence. Each power is complementary to the other, and their combination is, of course, necessary to the successful prosecution of such a war as that upon which Germany has deliberately engaged. In time of peace the two powers have little or nothing in common; they are, indeed, antipathetic and distrustful of each other. In time of war they agree to work together for a common aim.

In Mr. Gerard's remarkable book there is an enlightening chapter which reveals, to some extent, how organised capital in Germany, aided by the State, is still seeking to dominate the world, in spite of the many setbacks caused by the unexpected prolongation of the war. It is always well to learn from your enemy if you can. But even if you do not choose to follow his example, it is at least desirable to know what he is up to, for, says prudence, to be forewarned is to be forearmed. The American ex-Ambassador's chapter is primarily addressed, of course, to the American public, and is more immediately applicable to American laws and conditions, but there is much in it that bears directly upon our own circumstances, both at the moment and when peace is restored. For it is absolutely certain that no matter what the purely military result of the war may be, capital in Germany is organising itself in such a manner that it means to start an economic war against the world with the view of preserving, and, if possible, strengthening, such monopolies as it has hitherto possessed. The most valuable of these monopolies depend upon the application of physical science to industry. Such is the character of her educational equipment that she thinks she is secure in the continued development of her means of turning science to practical account; and she has probably good grounds for her faith. It is rather to the economic side—the purely business aspect of the problem—that she is bending all her energies and the financial ability and astuteness of her commercial magnates.

Some time before the outbreak of war, and probably in view of it, the six great companies, each employing hundreds of chemists in research work, which practically control the dyestuff industry of Germany made an alliance not only for the distribution of their products, but also for the exchange of their ideas and trade secrets. They work together as one organisation, are exceedingly wealthy, and have hitherto been well served by agents all the world over. These concerns manufacture not only dyestuffs, but also a large proportion of the synthetic drugs which are so characteristic a feature of modern therapeutics, and in very many cases are manufactured from what otherwise would be useless by-products of the dyestuff industry. The blockade of Germany has, of course, prevented any considerable export of these dyes and drugs, and most of the countries at war with Germany have sought to develop their manufacture at home. The commercial submarines *Deutschland* and *Bremen* were to a great extent built with money provided by the dyestuff manufacturers, who shipped their products over to America before her entrance into the war in order to check, if possible, the development of the colour industry in the States, the German Department of the Interior meanwhile stipulating that Germany should receive in exchange cotton, of which she was in urgent need. This traffic has, of course, now wholly ceased. To meet the competition which it recognises to be inevitable, the great combine has very largely increased its capital and is prepared to spend enormous sums to undersell its rivals and force them out of business, and it rests with the several Governments to take such measures as will effectually protect these menaced industries. An enlightened public opinion, which will refuse to be hoodwinked by the propaganda and "peaceful penetration" of the Germans, may do much to counteract their insidious efforts. Dyes and drugs of the synthetic kind are largely affairs of fashion, and both appeal more to women than to men. Owing to the imperious dictates of fashion, which loves change, there is a constant demand for new colours or shades of colour for which there is no absolute necessity. If women would only be content with a more limited range of dyes, of which there are many possessing every essential attribute of a satisfactory dyestuff—at all events until our own dyestuff industries are consolidated—half the battle would be won. As for the drugs, nine-tenths of them are worthless, and many of them are positively noxious. Many hundreds of them, the names of which are now forgotten, have been put upon the market by manufacturers solely in the attempt to exploit the by-products of the colour industry, and so long as fashionable practitioners can be induced to prescribe them and people induced to

drug themselves with them, novelties of the kind will continue to be supplied. But here, again, there is no necessity why one should succumb to the blandishments of the pushful "Kaufmann."

Combines or trusts of the kind we have indicated are looked askance at in this country and America as acting in restraint of competition. But in Germany, where they are known as "cartels," they are positively encouraged and upheld by the courts as a justifiable means of self-preservation. Under the post-war conditions which Germany intends to force upon us, this question needs very careful consideration, and it cannot be solved by economic formulæ which are supposed by doctrinaires to be as fixed and immutable as the law of gravitation.

One noteworthy outcome of the war in Germany has been the establishment by the State of a great institution known as the Central Einkauf Gesellschaft, whereby every importation of raw material into the country falls into the hands of this central buying corporation, which disposes of it under regulations to manufacturers. According to Mr. Gerard, this institution, which was created solely as a war measure, has come to stay. It is defended on the ground that it husbands the gold supply of Germany, prevents useless expenditure abroad, and benefits home industry. The Central Einkauf Gesellschaft will make its own purchases abroad, and as it will be a buyer on an enormous scale it will force the sellers to compete against each other in their anxiety to sell. In this way it is believed that the aggregate purchase will be effected at a lower rate than individual buyers would secure. The material will then be divided among the manufacturers at less eventual cost than if they had purchased it separately abroad. This is an example of socialised buying and selling which, if successful, is bound to have an enormous influence upon German commerce. Its very magnitude may, however, render it unworkable in practice. Should it prosper it will give a tremendous impetus to the cause of State Socialism.

Although there is much in Mr. Gerard's account of the manner in which Germany has grappled with the economic difficulties she has brought upon herself, which serves to illustrate her extraordinary powers of organisation and her well-drilled faculty of combination towards a common end, there are many instances of economic blunders on the part of departmental authorities, as, for example, Delbrück's treatment of the cyanide industry and the exportation of potash. In both these cases, and in others that might be mentioned, the anticipated result was altogether falsified by the event, and irreparable injury has probably been done to these industries in Germany. In the attempt to play off the United States against England, Germany was hoist with her own petard.

This fact is beginning to be perceived by the great mass of the commercial community in Germany and Austria-Hungary. Many industries are completely ruined already, and as the war continues to drag along others will share their fate. There are, however, some—powerful organisations like Krupp's and the great body of the Prussian Junkers and the landowners, who as growers of food are making money by the aid of the cheap labour of Russian and other prisoners—which will clamour for the continuance of the war so long as the dumb-driven common herd, who have no real leaders, are inarticulate, and have only a sham political representation, can be induced to tolerate their long-drawn-out agony. To Mr. Gerard it is a matter of surprise that the German manufacturers, who were enriching themselves so rapidly at the expense of the whole world by the aid of low wages and long hours, and with no laws against combination, should have allowed their military autocracy to drive them into war. They would probably have protested, with all the political power they possessed, had they foreseen that they would be up against four-fifths of the civilised world, and that, to use Dr. Helfferich's phrase, they would be doomed to drag about the leaden weight of the billions which this world calamity will have cost the country that really instigated it. No Pyrrhic victories can prevent the social and moral bankruptcy which will assuredly overtake Germany in the long run, and there are signs that this truth is being realised. Germany to-day suffers from the lack of a sane Liberalism, from the want of a strong party of moderate, clear-thinking men with sound political ideals and a larger measure of humanism than characterises the average Prussian. Politically she is torn asunder by two forces—a brutal and unscrupulous autocracy supported by a cunningly devised system of caste, and a Socialism the creed of which, in many of its moral aspects, is repugnant and hateful to all right-thinking men. Germany, like every other nation, has the Government she deserves, and she has brought her deserts upon her own head by her flagrant disregard of the nobler instincts of our common humanity.

T. E. THORPE.

THREE AMERICAN BOOKS FOR GARDENERS.

(1) *Greenhouses: Their Construction and Equipment.* By W. J. Wright. Pp. xvi+269. (New York: Orange Judd Company; London: Kegan Paul and Co., Ltd., 1917.) Price 1.60 dollars net.

(2) *Vegetable Forcing.* By Ralph L. Watts. Pp. xiv+431. (New York: Orange Judd Company, 1917.) Price 2 dollars net.

(3) *Modern Propagation of Tree Fruits.* By Prof. B. S. Brown. Pp. xi+174. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 6*s.* net.

(1) BY the skilful use of glass and artificial heat, gardeners have succeeded in the cultivation of tropical plants in temperate countries. Greenhouse gardening is comparatively modern, for although the Romans, before the time of Christ, knew how to force fruit and vegetables, they applied only hot manure for the purpose, and it was not until the early part of the eighteenth century that glass structures arti-

ficially heated were used for the cultivation of tender plants. Since then, however, the evolution of the greenhouse has been rapid. There are now glass structures, acres in extent, so cleverly made that the cultivation of plants in them is as successful as in the open with the most favourable weather conditions. The market gardeners of England have in the last fifty years made great progress in the art of glasshouse gardening, and in the United States, where the sun affords in winter more heat and light than it does here, huge structures are erected for the forcing of flowers and vegetables.

Mr. Wright, director of the New York State School of Agriculture and formerly a professor of horticulture, has collected in his book a large amount of helpful information concerning the location, adaptation, erection, and equipment of greenhouses to suit American weather conditions and requirements, which both builders and gardeners will be certain to appreciate.

The conditions in England are somewhat different; still, a great deal of Mr. Wright's teaching may be applied in the making of houses, frames, etc., in this country, and in methods of heating them. Our old greenhouses are too heavy and obstruct the light too much. A good plant-house must be strong, yet light, and it must cast very little shade. The angle of the roof, quality of glass, methods of ventilation, and the internal arrangements with respect to benches and floors are all questions of great importance, as Mr. Wright clearly shows in his well-illustrated chapters.

(2) Vegetable forcing as practised in the United States is the subject of an excellent treatise by Mr. Watts, Dean and Director of the School of Agriculture and Experiment Station at Pennsylvania State College. Forcing as practised in horticulture is the application of artificial heat to the growth of plants out of season. It is now very largely resorted to for the production of food vegetables in winter, enormous quantities of fresh, wholesome vegetables being grown in this and other countries where, without it, they would be difficult to obtain. It is also largely practised for the production of certain flowers, especially roses, carnations, daffodils, and violets. Where sunshine in winter is fairly constant successful forcing is easy, as, for instance, in the United States, where there is far more winter sunshine than in England. In greenhouses and frames specially constructed for the purpose perfect crops are produced in midwinter of such vegetables as cabbage, cauliflower, lettuce, radish, tomato, cucumber, rhubarb, asparagus, French bean, and mushroom. A knowledge of the treatment of soils, suitable manures, right temperatures and ventilation is necessary, and is best obtained by actual experience. Useful guidance can also be obtained from books, such as that by Mr. Watts, which sets forth the best methods of the American practitioners. They believe in soil sterilisation by means of steam or formalin. It is found that the soil continues to be productive year after year when it is annually sterilised, whereas without this it becomes "sick" and infested with fungi and other causes of disease in plants. Stable manure is preferred to all other fertilisers, but nitrate of soda is sometimes used as a growth stimulator. Greenhouse construction, heating, insect enemies and diseases, and marketing are carefully treated. The statement that plants are rendered susceptible to disease by high temperatures, excess of water, and over-manuring will be endorsed by practical cultivators in this country.

(3) The propagation of fruit trees by means of grafting, budding, layering, and cuttings is essentially the same in all countries. The methods vary, as does the skill with which the operations are performed. In America, where fruit-growing is done on a very large scale, labour-saving methods are practised. Orchards miles in area have to be planted and worked, for which men with spades and pruning-knives would be as inadequate as they would be for agriculture. The alert Americans have therefore sought the assistance of the machine-maker for their digging and planting operations, and even for binding in the operation of grafting.

Prof. Brown's book enables us to realise what a big industry fruit-growing has become in America. There are nurserymen there who each dispose of young trees by the million annually. "The growing of all the twenty to forty millions of American-grown apple seedlings that are used in this country every year is undertaken by less than a dozen firms." In addition, large quantities of young trees, both stocks and "maidens," are imported from Europe. At this rate America will soon be covered with fruit trees unless they are used up quickly, as roses are in that country. Some of our own fruit authorities advocate this intensive system on the ground that young trees properly managed give their best in the first few years, after which they should be scrapped. Apples, pears, plums, cherries, peaches, and a few other fruits are invariably grafted or budded on stocks known to influence growth and fruitfulness. Too little care, however, is exercised in the selection of stocks. Prof. Brown discusses the influence of scion on stock in regard to commercial fruit trees. His book is written for students, a number of what he calls "review questions" being set out at the end of each chapter, such as "What is meant by influence of stock over scion?" It contains numerous helpful illustrations.

W. W.

ANALYTICAL DYNAMICS.

A Treatise on the Analytical Dynamics of Particles and Rigid Bodies: with an introduction to the Problem of Three Bodies. By Prof. E. T. Whittaker. Second edition. Pp. xii+432. (Cambridge: At the University Press, 1917.) Price 15s. net.

THE first edition of this book was reviewed in NATURE of April 27, 1905. At that time what we now call aeroplanes only existed in

people's imagination and in reports of successes by the Wright brothers, and it was scarcely to be wondered at if applications to aerial navigation found no suitable place in a treatise on analytical dynamics. In the twelve years that have elapsed there has been plenty of time for pure and applied mathematicians to provide material that would not occupy merely a single chapter on "The Aeroplane" in a second edition of such a book as this, but might even form a predominating feature of the whole work. Yet on referring to the index we do not even find the word "aeroplane," while the references under "stability" and "resistance of the air" do not lead to any matter suggestive, even vaguely, of the existence of aerial navigation. It may well be a matter of surprise that such an omission should be possible at the present day.

We cannot lay the blame on Prof. Whittaker, because a book of this kind is necessarily largely an exposition and collation of the work of other writers. But it will be found on closer examination that, outside the problem of small oscillations about a state of steady motion, very little work has been done in advancing what is really out-and-out the most important development of theoretical dynamics, and for the most recent of the developments which have taken place physicists and engineers rather than mathematicians are mainly responsible, much of their work being the property of the Government at present.

It is, however, rather a pity that Prof. Whittaker has omitted to introduce the subject under the heading of "stability of steady motion," as this would, at least, afford his readers some stimulus to turn their studies in the right direction. Possibly the author considered it scarcely desirable to make any change until further developments had taken place, and in this second edition he has rather confined his attention to elaborating references to original work on old ground. It is not usual in reviews to repeat what has been said in a previous notice about a first edition. For this reason a detailed account of the actual contents would be scarcely necessary or desirable. The present work will be found of much use by such students of a future generation as are able to find time to extend their study of particle and rigid dynamics outside the requirements of aerial navigation, and it will also afford a valuable source of information for those who are in search of new material of a theoretical character which they can take over and apply to any particular class of investigation.

G. H. B.

OUR BOOKSHELF.

Origenes y Tendencias de la Eugenia Moderna. By Joaquin Bonilla. Pp. 96. (Liverpool: *Daily Mail* (printers), 1916.) Price 3s. 6d. net.

THIS introduction to eugenics is intended primarily for Latin America. The author explains the aims of eugenics, and gives a sketch of the history of the idea of trying to control the agencies which improve or impair racial qualities in mankind. Simple expositions are given of Lamarckism, Darwinism, Mendelism, and Weismannism. There is a pleasant appreciation of the work of Sir Francis Galton, and the book pays due regard to experimenters and biometricians alike. The endeavours of the Eugenics Education Society are recognised, as well as the work of Prof. Karl Pearson's Eugenics Laboratory. So up-to-date is the book that mention is made of England's "Baby Week" and of the withdrawal of the veto on the representation of certain plays by Ibsen and Brieux. A chapter is devoted to eugenic activities in the United States.

The author has the wise and kindly intention of familiarising Spanish-speaking young people with the aims and methods of eugenics, and he seems to us to have written a clear and terse introduction to the subject. We should like to have seen some recognition of what is practicable in the way of ameliorating environment and function, and improving nurture generally. For the eugenic ideal does not, and cannot, stand alone. In a short book like this it should have been readily possible to avoid disfiguring verbal errors, such as Seleeby, Burcke, Havelock Elliott, and Weisner; but these are very small flies indeed in the carefully prepared ointment. We wish the book success.

The Human Body: An Account of its Structure and Activities and the Conditions of its Healthy Working. By Prof. H. Newell Martin. Tenth edition, thoroughly revised by Prof. E. G. Martin. Pp. xviii+649. (New York: H. Holt and Co., 1917.)

A BOOK which has reached a tenth edition needs but little recommendation. The late Prof. Newell Martin's work, like all that he did, is excellent. It is rather more bulky than the majority of books of an elementary nature; but, like these, it is a compendium of anatomy and physiology designed, not for the student of medicine, but for the general reader who desires to become acquainted with the mechanism of his own body and the reasons for the laws of health. It is naturally the physiological side which is mainly dwelt upon, only so much of structure being described as is necessary for the understanding of function. The present edition has been brought well up to date, and, like the only other book with which we may compare it, Huxley's "Elementary Physiology," has doubtless still before it a long and useful life.

A welcome feature of the book is the appendix, in which instructions for practical work are given in detail. Much of this will need a laboratory, but it is astonishing how much useful practical work can be performed without elaborate apparatus, and with the resources which are available to nearly every teacher.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The January Meteors of 1918.

I WATCHED the northern sky during most of the interval between 6h. and 10h. on January 3, and recorded eleven Quadrantids. The conditions were not good; there was a slight fog, through which the stars of Ursa, Draco, etc., shone dimly, and the air was frosty, the temperature being about 26°.

The Quadrantids observed were, in the majority of cases, near their radiant at $233° + 59\frac{1}{2}°$, and moved slowly. This position is near ι Draconis, and about 6° north of that usually determined in past years. I am at a loss to explain the cause of the discordance, the data of the present year being considered quite satisfactory. In the circumstances the results recently obtained by other observers will be awaited with special interest.

W. F. DENNING.

44 Egerton Road, Bristol.

THIS evening, between 6 p.m. and 9 p.m., looking north, twenty-two meteors were observed at Sidmouth, South Devon. The most brilliant one appeared about 8.15 p.m. G.M.T., and was travelling in a south-easterly direction at a moderate speed. The meteor was of a reddish colour, and was followed by a long trail of white light. It was frosty and beautifully clear, excepting a slight haze for a short interval.

WINIFRED L. LOCKYER.

Salcombe Regis, Sidmouth, January 3.

NATIONAL MUSEUMS IN PERIL.

THE report that the Government proposed to requisition the British Museum as the headquarters of the new Air Board has resulted in a storm of protest from many men of light and leading throughout the country, and from corporate bodies concerned with the promotion of the intellectual welfare of the nation. The correspondence published in the *Times* and other journals represents only a small fraction of the budgets received, and it is evident that the Government will bring upon itself nothing but obloquy if it persists in the action contemplated. Since we referred last week to the projected dismantling of the galleries at Bloomsbury, it has been made known that the Office of Works has surveyed the Natural History Museum at South Kensington with the view of using the building for the purposes of other Government departments, and has reported in favour of doing so. The very existence of our two greatest national institutions is thus threatened, unless a united effort is made at once to convince the Cabinet of the unnecessary and ruinous proceeding to which certain administrative officials, with the usual indifference to scientific interests and inability to understand scientific values, desire to commit it.

The high-handed method adopted in the proposal to commandeer the two museums cannot be justified even by the provisions of the Defence of the Realm Act. Sir Arthur Evans states that the trustees of the British Museum were not consulted upon the matter, though they are responsible for the collections, not as Government nominees, but under an Act of Parliament. They were astounded upon receiving from the Air Board a requisition for the building to house the Board's establishment, and at once sent a strong protest to the Government against the scheme. Even an enemy invader could not adopt a more arrogant attitude towards the trustees than that shown by the representatives of the Government. The collections were regarded as so much furniture which could be packed up in a few days by workmen and conveyed in pantechnicons to convenient places of storage until after the war. As "A Londoner" writes in the *Times* of January 4 in an attempt to justify the official attitude: "It is pretty widely understood that the Air Board is willing and anxious to put its large resources in transport and labour at the service of the nation for the removal of the contents of the British Museum to places of safety which the Board has already inspected and approved."

This semi-official pronouncement reveals entire incapacity to appreciate the difficulty of the problem of dealing with the contents of the museum. The whole of the objects are considered as goods which may be removed in a few days and returned without detriment at a later period of reconstruction. Because a selected number of objects have been carefully transferred to places of security by museum officials during the past two years, as a precaution against air-raids, it is assumed that the whole may be dealt with summarily by energetic workmen under the supervision of experts. The absurdity of this view will be manifest to anyone acquainted with museum work. To make a selection of fragile objects and other national treasures, and to take measures to preserve them from damage, are very different matters from that of clearing space without reference to what it occupies. It is certain that if the indiscriminate and hurried dismantling of the museum is proceeded with, many of the objects taken away will never be worth bringing back, and it would be just as well to make a bonfire of them at once.

Only a small proportion of the contents of the museum could be removed in time for the space they occupy to be of any use to the Air Board. The library must remain, and the larger sculptures, including the more important pieces of the Elgin marbles, the Assyrian bas-reliefs, and the Egyptian statuary. The ethnographical collections cannot be disturbed without certain destruction of many objects. The glass, pottery, porcelain, and faience collections, the ancient and medieval gems, rings, and jewelry, the Greek vases, the Babylonian clay tablets, the Egyptian pottery and images, the terra-cottas, the bronzes —all these can be moved only with an infinitude of skilled handling and packing, and in a period of time which might well run into years rather than months. No, it must be clearly understood that if the museum is to be taken for the Air Board—

which needs offices quickly—the Board will have to be encamped in the middle of the collections, with all the increase of risk which such an encampment involves.

Our concern for the museum is not prompted by opposition to interference with the existence and work of the threatened institution, but by the desire to preserve national prestige and to prevent the ruin of possessions which can never be replaced. Only if reduced to the last extremity—and we are far from that condition—should a scheme be adopted which would give the enemy occasion to scoff at our willing sacrifice of the glorious heritage represented by the collections in the national museum.

"We profess to feel shame and anger," says Sir Henry H. Howorth, "and also terror for the future of our race, when we find the champions of German culture destroying Reims and Padua and Ypres. We call them Huns for their pains, and at the same time in another way, and for no urgent military purpose, ourselves put in jeopardy the noblest collections in the world of art and natural science, which neither money nor skill can replace, and which form the most valuable asset of the country if its mental and moral training are to count in this Armageddon of materialism."

The gravamen of the case against the proposed action is, indeed, that it shows a total lack of imagination and of perception of the value of intellectual studies on the part of responsible Ministers. They accept lightly, and without investigation, a proposal which, on the face of it, imperils the inestimable treasures of the British Museum. They do not consult the trustees as to the effect of their proposed action. They do not give heed to their own Minister of Education. They simply accept a scheme put forward by the First Commissioner of Works, who avowedly has not visited the museum to investigate its practicability, and whose expert advisers had on two previous occasions reported that the museum was not suitable for a public office. All this shows an indifference to things of the mind and a materialistic spirit which are of evil omen in statesmen whose business it is to maintain the ideals of the country at a high level, and thereby to hearten it to bear the strain of war. Who is to believe them in future when in their speeches they make play with Germany's crimes against civilisation, or exalt our ideals in comparison with German Kultur? They are lowering the pitch of England's endeavour, and the misfortune is that they do not realise that they are doing any harm in this action. If the members of the Government could be brought to face these facts, it is difficult to believe that they would continue to insist on a policy which is bad for the Air Board, bad for the museum, and a discredit to the country.

Though the spontaneous outbursts of indignation from all parts of the country may yet induce the Government to withhold the impious hand which the Office of Works laid upon the collections and buildings of the British Museum at Bloomsbury, the fate of the Natural History Departments at South Kensington also trembles in the balance. Yet the arguments drawn from unsuitability of structure and fragility of irreplaceable specimens are here no less strong, and they are reinforced by two others. The work in all the Natural History Departments bears directly on the material as well as on the intellectual life of the nation—indeed, on its very existence. Those who say that prosecution of the war must come first should be the first to insist on the continuance of the great help rendered by the museum to all branches of our fighting forces: we may refer them to an article in the *Times* for January 5. To stop this work for the convenience of the Registry of Friendly Societies would be a fine stroke for our enemies. Secondly, the objects in the Natural History Museum form the historical basis on which a great part of natural science rests; they are the standards to which present and future generations must continually refer. To destroy or damage them is to cut away the ladder on which we climb. The distinguished men responsible to the nation for the safety of its unique possessions—trustees, indeed, for the whole world now and to come—have already taken steps against possible attack by the enemy, while leaving the specimens available for accredited investigators. But they cannot prevent the certain destruction and widespread confusion that would result from a sudden clearance of more than half the building as though it were just a mammoth hotel. The removal from Bloomsbury took more than three years, yet, for all the care with which it was accomplished, it left damage which is not yet, and can never be entirely, repaired. When we think of the subsequent growth of the collections and the present depletion of an always insufficient staff, our imagination fails to grasp the threatened ruin. Generations could not restore it. For many a year the science of our country would be hampered.

In the early days of the war we had to fight for our national museum, and well was it that we won a partial victory. Since then the members of the staff unfit for military service have carried on, with what good results a few bald statistics will show. During the past year the Natural History Museum has been consulted by at least fourteen Government departments, as well as by numerous individuals engaged in war-work. The number of visitors, which in 1916 was more than 402,000, was increased in 1917 by 20,000; among these are soldiers receiving class-instruction in sanitary, veterinary, and other subjects. The annual number of acquisitions has decreased, because all purchases are stopped, but donations continue to flow in with a volume that seems to grow rather than diminish. Among these accessions have been thousands of specimens of the highest scientific importance. The dismantling of the museum would make the receipt of donations impossible, and the stream would be diverted elsewhere. In some cases it would never return.

"We are blamed," says the Government in

effect, "for commandeering hotels; we must leave places for our young officers to dine; do you expect us to oust another political club? We preach economy; do let us practise it for once. We can get the museum *rent-free.*" Rent-free, indeed! Is the cost of structural alterations, of packing, of removal, and of restoration not to be paid for? Does the scientific help for our food-producers, our industrialists, and our fighting or wounded men weigh as nothing in the balance? Are the gifts which you reject devoid even of pecuniary value? "What should ye do, then? Should ye suppress all this flowery crop of knowledge and new light sprung up and yet springing daily in this city? Should ye set an oligarchy of twenty engrossers over it, to bring a famine upon our minds again, when we shall know nothing but what is measured to us by their bushel?"[1] "Milton!" we cry with Wordsworth:

> Milton! thou should'st be living at this hour:
> England hath need of thee.

The following are a few of the resolutions which have been passed by important public bodies protesting against the proposed employment of the museums for purposes other than those for which they are intended:—

At a special meeting of the British Academy on January 3 it was resolved to represent to his Majesty's Government the irreparable injury that would be done to the interests of learning and humane studies by any serious damage to the priceless collections in the British Museum, and the slur which would be cast on the good name of the country by action which will be taken as implying indifference to those collections and to the civilisation they represent. To remove any considerable portion of the collections, except with the utmost care and the expenditure of many months of skilled labour, is impossible without the certainty of injury; and to house a large combatant department in the midst of the collections themselves involves a great increase in the risk of accident and fire, quite apart from the danger of air attack from hostile aircraft, which would obviously be much increased. The Academy earnestly appeals to his Majesty's Government not to sanction action which would discredit this country in the eyes of the civilised world.

The fellows of the Linnean Society of London in extraordinary general meeting assembled on January 7 placed upon record their profound astonishment and alarm at the reported intention to dismantle the British Museum, including the Natural History Museum, in order to use it for Government offices; their emphatic protest at a procedure which must endanger priceless and irreplaceable possessions acquired at great cost and infinite labour during the last two hundred years, constituting the most splendid museum in existence, and the recognised centre of systematic scientific research; their dismay at a resolution which must paralyse scientific activities that during the past three years have been devoted to work intimately connected with the prosecution of the war; and at the expenditure of a large sum in adapting unsuitable buildings, whilst other and more suitable accommodation might be provided at much less cost; and, finally, to emphasise the disgrace which must accrue to the nation in the eyes of the whole world by the evidence thus afforded of the inability of the Government to appreciate the essential value to the nation of scientific assistance, such as the British Museum has rendered and is capable of rendering

The Entomological Society of London has resolved: This society, founded for the advancement and practical application of entomological science, knowing that this science, especially at the present moment, plays a most important part in many questions, often of extreme urgency, affecting the health of the nation and its forces at home and abroad, its food supplies, its timber, and the raw material of its manufactures, views with the gravest concern any action that would impede work essential to the national welfare. Towards the solution of these problems the collections at the museum have in the past largely contributed, and many of them are at present under investigation. The proposed action of his Majesty's Government in reference to the Natural History Museum would have a disastrous effect upon work which demands continued reference to its enormous collections. It is obvious that to be of any practical value these must always be readily available, and, moreover, their removal would not only be a very lengthy undertaking, but could not be carried out without irreparable damage. The Entomological Society of London feels bound, therefore, to enter the strongest possible protest against such proposed action, the full consequences of which can scarcely have been realised, and in the interests of the Empire urges that the suggested interference with these important collections should be abandoned.

At a meeting of the council of the Mineralogical Society of Great Britain and Ireland, held on January 7, it was resolved: That the First Commissioner of Works and the War Cabinet be most earnestly requested to reconsider the proposal to utilise a portion or the whole of the Natural History Museum for other than its present purpose. In particular, as regards the Mineral Department, the Mineralogical Society views with alarm any proposal to render inaccessible, both to the general public and students, and also to inquirers respecting economic questions, the national collection of minerals, which has been accumulated during the past century and a half, and is now the largest and most complete in the world. This collection contains, for reference and comparison, examples of all minerals (and ores) that have been put to economic uses, representing numerous localities that have not yet been worked commercially. Direct reference to those parts of the collection not exhibited to the general public would supply a large amount of information, not available elsewhere, even in published works, respecting mineral occurrences in all parts of the world. Such information has already been utilised by the Advisory Council on Scientific and Industrial Research, by the War Office, and by the Department for the Development of Mineral Resources attached to the Ministry of Munitions of War, and could also be of use to the proposed Imperial Mineral Resources Bureau. The proposal to render such information inaccessible would seriously hamper the work of all Government departments concerned with the development of the mineral resources of the Empire.

At a special meeting of the council of the Essex Field Club, held on January 7, it was unanimously resolved: That the council of the Essex Field Club learns with amazement that the Government contemplates occupying the British Museum, including the Natural History Museum, for departmental offices, and hereby expresses an indignant protest against such action, which is certain to result in irreparable injury

[1] Milton's "Areopagitica."

to the invaluable collections in the museums and in the cessation of much scientific work which is dependent upon such collections. That such action, in the opinion of this council, could not fail to bring discredit upon our nation in the eyes of all civilised peoples.

On January 7 it was resolved: That the Classical Association appeals to the Government against the proposed conversion of the buildings of the British Museum into a seat of combatant activity, both because of the inevitable injury that would be caused by removal to a multitude of objects of unique historical value, and because the change would legitimate and incite attacks from the air upon a library containing many thousands of irreplaceable books and MSS. which constitute a great part of the inheritance of the civilised world. Their safe-keeping is a trust for humanity imposed by history upon this country, and the association regards the present proposal as a declension from the high ideals with which the country and the Empire entered on the war.

Similar resolutions have been passed by the British Archæological Association, the annual Conference of Educational Associations, the Royal Society of Antiquaries of Ireland, the Royal Asiatic Society, the Royal Numismatic Society, the Cambridge Antiquarian Society, and many other representative bodies.

SANDS FOR GLASS MANUFACTURE.[1]

THE preface to this memoir refers to the great advantage which the glass industry of this country is deriving from the prescient policy of the Department of Optical Munitions and Glassware Supply of the Ministry of Munitions; and the memoir itself is an example of the department's efforts to place the industry in a sound position. A knowledge of the home resources of raw materials is of prime importance to the glass industry, and the exhaustive survey made by the author has enabled him to place on record for the first time valuable information as to the resources of suitable sands on which the glass manufacturer can rely. In pre-war days large quantities of excellent sand were imported from Belgium and France, and their cheapness was mainly due to their transport as ballast in coal-boats. Economic conditions may prevent the utilisation of many of the occurrences of sands and rocks to which the memoir refers, but much will depend on the provision of cheap transport by the adequate development of our canal systems. This is well shown by the sketch-map marking the locations of the chief resources of glass sands in relation to the glass-making areas.

A glass sand should be of uniform grain size, and the most desirable sands are those containing a high proportion of grains from 0·25 to 0·5 mm. in diameter. The presence of grains smaller than 0·1 mm. causes the formation of "seed," which is difficult to remove in the "fining" process. An even grade is also an important factor in securing homogeneity, and it is doubtful if stirring can completely eliminate heterogeneity caused by the use of badly graded, unevenly melting sands. An important conclusion to be drawn from the author's investigations is that although we have not in this country any deposit equal in quality, uniformity, and extent to that at Fontainebleau, we have ample supplies of sands suitable for all ordinary glass-making purposes. Carefully selected sands from the soft white quartzites of Muckish Mountain contain under 0·01 per cent. of iron oxide, and this source is of great importance, as, despite its inaccessibility, it is likely to provide a home supply of the small quantities of sand required for the manufacture of optical glass. Generally speaking, although crushed rocks are largely used in the American glass industry, they cannot for economic reasons be regarded as an immediate source of supply of glass sands in this country.

Sand-pit owners are now giving greater attention to the cleansing and grading of sand by washing, and the improvement which can be effected in the quality of a sand is indicated in the tables given on p. 64 of the memoir. It would have been of interest if quantitative information as to the yield of washed sand could have been added to these tables. The washers at present in use are satisfactory for comparatively coarse sands of the Leighton Buzzard type, but are much less efficient for finer-grained sands, such as those of Lynn and Aylesbury. Provided that a plentiful supply of water is available, there should be no great difficulty in designing an efficient washer for fine-grained sands, and co-operation between the glass manufacturer and the sand-pit owner is desirable if adequate washing plant is to be installed. Sands low in iron will be preferably graded by drying and sieving, instead of washing, so as to retain the alumina-rich coating which is adherent to the quartz grains. Alumina is valuable in a glass, as not only does it reduce the tendency of the molten glass to devitrify, but it also increases the toughness of the glass and enables the batch to be cheapened by increasing the proportions of sand and lime at the expense of the alkali. Felspar is being increasingly used as a source of alumina in a glass batch, and the author's survey of the resources of suitable rocks of low iron content is of value as an indication of the possibility of substituting the home for the imported material.

The uses of sand for its refractory properties are referred to only briefly, and the further memoir on our home resources of refractory sands will be awaited with interest.

Prof. Boswell has rendered a distinct service to the glass industry by this rapid completion of his survey.

[1] "A Supplementary Memoir on British Resources of Sands and Rocks used in Glass Manufacture, with Notes on certain Refractory Materials." By Prof. G. H. Boswell and others. Pp. 92. (London: Longmans and Co., 1917.) Price 3s. net.

ORGANISATION FOR INDUSTRIAL EXPANSION IN SOUTH AFRICA.

IN an article on "The Co-ordination of Research" which appeared in NATURE of December 6 mention was made incidentally of the issue of the *South African Journal of Industries.* Copies of the first number of this journal have now reached this country. Before alluding to the scope of the new journal it should be explained that the Scientific and Technical Committee appointed by the Department of Mines and Industries of the Union of South Africa has for its prin-

cipal functions the conduct of an economic survey of the natural resources of South Africa, the extension of provision for industrial research, co-ordination of industrial investigation, the elimination of overlapping in such work, and the provision of means for taking advantage of facilities for investigation not available in South Africa by co-operation with similar organisations in the United Kingdom and the other British dominions. The committee has so far made two chief recommendations, viz. (1) the appointment of various authorities in South Africa to report on the natural resources of the country, and (2) the publication of an industrial journal to give publicity to the reports and data collected under the committee's auspices. The first of these recommendations is being carried out, and the second has been given effect to in the issue of the *South African Journal of Industries*.

In common with most of the overseas British dominions South Africa, largely as a result of the war, is in the throes of new industrial developments with the view of providing the necessaries it formerly imported, but which it can no longer procure from the manufacturing countries in Europe. The first number of the journal is naturally largely occupied with articles surveying the present situation. Among these may be mentioned Mr. Warington Smyth's article on "The Beginnings of Organisation for Industrial Expansion"; that on the "Census of Manufacturing Industries, 1917," by Mr. C. W. Cousins, Acting Director of the Census; and Dr. Lehfeldt's report on "The Economics of Agricultural Production in South Africa." Among the new South African industries to which attention is directed is the manufacture of industrial alcohol, for use as a motor fuel, from the molasses produced on sugar estates in Natal. A report by the Imperial Institute on the results of examination of the fruits of *Ximenia americana* is printed, and Dr. Philips contributes a useful *résumé* of the information available regarding "buchu," a drug the production of which is a monopoly of South Africa.

The article in NATURE already mentioned directs attention to the difficulties of co-ordinating industrial research in the United Kingdom, and shows that there is no evidence that such co-ordination has yet been effected or is in process of being arranged. The appearance of the *South African Journal of Industries* is a reminder of the existence of the larger and still more difficult problem of devising means for the utilisation of the resources of the Empire within the Empire itself, and the solution of which is of first-rate importance to both British and Colonial industries.

NOTES.

AMONG the promotions in and appointments to the Most Excellent Order of the British Empire for services in connection with the war announced on Tuesday, we notice the following:—*Knights Commanders (K.B.E.)*: Mr. James Cantlie, member of Council and of Executive Committee, British Red Cross Society; Col. C. F. Close, Director-General of the Ordnance Survey of the United Kingdom; Dr. W. Morley Fletcher, secretary of the Medical Research Committee; Dr. J. Galloway, Chief Commissioner for Medical Services, Ministry of National Service; Dr. R. Robertson, superintending chemist, Research Department, Woolwich Arsenal; Prof. W. H. Thompson, scientific adviser to the Ministry of Food. *Commanders (C.B.E.)*: Prof. F. J. Cheshire, adviser on scientific side of Optical Munitions Branch, Ministry of Munitions; Dr. G. H. Fowler, Hydrographic Department, Admiralty; Prof. W. R. Hodgkinson, professor of chemistry and metallurgy, Ordnance College, Woolwich; Mr. R. G. K. Lempfert, Superintendent of the Forecast Division, Meteorological Office; Prof. W. J. Pope, professor of chemistry, University of Cambridge, member of panel of Board of Invention and Research, Admiralty; Prof. T. B. Wood, Drapers professor of agriculture in the University of Cambridge, adviser on meat production to the President of the Board of Agriculture, and chief executive officer, Army Cattle Purchase Scheme; Mr. G. Udny Yule, Director of Requirements, Ministry of Food. In addition, about two thousand names are included in lists of new officers and members of the Order (O.B.E. and M.B.E.).—Prof. James Ritchie, Irvine professor of bacteriology, University of Edinburgh, asks us to correct the mistake made in last week's issue of NATURE announcing that a baronetcy had been conferred upon him. The recipient of the distinction was not Prof. Ritchie, but Sir James W. Ritchie, son of a former Lord Mayor of London. We regret the error, but the Press announcement that it was Prof. Ritchie who had received the honour was perhaps a natural one for a scientific journal to accept.

Is the Carnegie Trust for the Universities of Scotland doing its duty in strengthening and developing scientific study and research? That is the question suggested by the report of a special committee published in the December number of the Journal of the British Science Guild. The question was first raised in an incisive manner by Prof. Soddy in an article communicated to *Science Progress* (January, 1917), and further inquiry seems to show that his contention is well founded. There may be some difference of opinion as to the exact interpretation of Clause A of the Trust Constitution; but there can be no doubt that the main object of the trust is to foster science, pure and applied, in all its branches, and to strengthen that side of university education which is of direct technical or commercial value. In the light of that general principle the following facts are well worthy of careful consideration:—(1) Only 14 per cent. of the available funds have been expended on scientific research; (2) by endowment out of Carnegie Funds of certain scientific departments, money formerly spent in their maintenance has been diverted into other channels, so that the university on its scientific side has not really been strengthened; (3) among the twenty-two members of the Board of Trustees, there have never been more, and have usually been fewer, than four who could be regarded as representing science, the majority being practically ignorant of the methods, and even the meaning, of research.

STEPS are being taken to incorporate the Selborne Society and to widen its objects, so that it may not in any way be hampered in its efforts to bring home to the public, especially through its lecturers, the great value of science to the community.

THE death is announced, on January 5, in his sixty-seventh year, of Mr. R. C. Woodcock, fellow of the Institute of Chemistry and of the Chemical Society, and author of a number of papers upon analytical chemistry.

THE death is announced, in his seventy-sixth year, of Dr. W. L. Purves, consulting aural surgeon, Guy's Hospital, consulting ophthalmic and aural surgeon, Hospital for Diseases of the Nervous System, and aural surgeon to the Royal Normal College and Academy of Music for the Blind.

AT the scientific meeting of the Royal Dublin Society held on December 19 last, Lord Rathdonnell, president, in the chair, the Boyle medal of the society was presented to Prof. J. A. McClelland, F.R.S., in recognition of his distinguished work in many branches of science, especially with those dealing with ionisation, and the more recently discovered forms of radiation associated pre-eminently with radio-activity.

THE death occurred on December 30, at the age of sixty-four years, of Sir William H. Lindley. To those who knew of the service Sir William rendered to the Royal Commission on Canals and Inland Navigation by the compilation of an exhaustive report on the waterways of France, Belgium, Germany, and Holland, published in vol. vi. of the Commission Bluebooks, the announcement of the knighthood, conferred upon him in 1911, came as no surprise. But to the general public his reputation was not so familiar, and this is scarcely surprising, seeing that the sphere of his professional activities lay almost entirely on the Continent, particularly in Germany and Austria-Hungary, where he succeeded to his father's position and influence. Sir William began his career in 1870, as resident engineer on the Budapest waterworks, and, three years later, took up the post of engineer to the city of Frankfort-on-Main, where, for more than twenty years, he administered the works of the municipality and port. During his lifetime he had associations with the towns of Elberfeld, Homburg, Mannheim, Wurzburg, Cracow, Prague, Warsaw, Bukharest, and Baku, in connection with various electricity, waterworks, and sewerage undertakings. But for certain adverse circumstances Petrograd would have been added to the list, for, as recently as 1912, he was appointed engineer-in-chief of a new municipal water-supply and drainage scheme for the Russian capital; the project, however, did not mature. His reputation among German engineers was deservedly high, and he discharged presidential functions on several Commissions. He had been a member of the Institution of Civil Engineers since 1878.

THE following minute, adopted by the board of trustees of the New York Memorial Hospital, is published in *Science*:—Dr. Richard Weil, Major in the Medical Reserve Corps, U.S.A., died while on active duty at Camp Wheeler, Macon, Ga., November 19, 1917. By his death the Memorial Hospital loses one of the most highly trained and successful workers of its medical staff, and American cancer research one of its recognised leaders. Since 1906 Dr. Weil had been an active member of the staff of the Huntington Fund, and throughout this period of eleven years he was constantly engaged in the problems of cancer research. His contributions in the field of the serology of cancer and in the general problems of immunity gained for him an international reputation. He was one of the founders of the American Association for Cancer Research, and largely through his efforts was founded the *Journal of Cancer Research*, of which he was editor-in-chief. At the reorganisation of the Memorial Hospital in 1913, Dr. Weil assumed the position of assistant director of cancer research and attending physician to the hospital, and in this capacity he laboured energetically to establish an efficient organisation of the routine and research work of the hospital. In 1915 he resigned the position of assistant director upon his appointment as professor of experimental medicine in Cornell University, but he continued without interruption his experimental work in cancer. Upon the declaration of war he was among the first to offer his services to the Government, and spent the summer at Fort Benjamin Harrison in the Medical Officers Training Corps. Quite recently he was detailed to take charge of a large military hospital at Camp Wheeler, Macon, Ga., and here in the performance of strenuous military service he fell a victim to pneumonia. During his brief but brilliant career he attained eminence as a devoted laboratory worker, a skilful experimenter, a broadly trained clinician, and a forceful writer, while his untimely death places his name among the first on his country's honour roll in the great war.

A REPORT containing the results of Dr. Benjamin Moore's researches on "The Causation and Prevention of Trinitrotoluene Poisoning" has just been issued by the Medical Research Committee (Special Report Series No. 11). It is shown that the only important avenue of entrance into the body is through the skin. The amount taken in as vapour or as dust is innocuous. The first noticeable indications of poisoning are those due to deficient oxygen supply, especially blueness of the skin and lips. This results from the action of the poison in decreasing the capacity of hæmoglobin to take up oxygen, a well-known effect on the respiratory process produced by nitro- and amino-benzene derivatives in general. Trinitrotoluene is said to convert hæmoglobin into its NO derivative, together with met-hæmoglobin. Various results follow from the deficiency of oxygen supply to the organs, but whether the degeneration of the liver and the consequent jaundice are secondary, as Dr. Moore holds, or whether the poison acts directly on the liver cells, is at present a matter of dispute. The same may be said for the anæmia. But the practical point is that the cyanosis is the sign to be looked for. Individuals differ in the property of their skins to absorb the poison, and it is recommended that all those showing susceptibility should be rigorously excluded from the work. A further preventive is covering the arms and hands with a casein varnish. Gloves are useless. The poison is reduced in the body, probably by the liver, to the hydroxylamino-derivative, and eliminated in the urine, conjugated with glucuronic acid. It is important, therefore, that the diet should include substances which afford a supply of this acid—namely, fresh vegetables and fruit.

Engineering, in its leading article for January 4, deals with standard aero-engine production, which in this country is in a state of chaos. More than forty different types of aero-engines are now being manufactured in Britain, and about as many firms are engaged in their manufacture. The labour absorbed in the extravagant multiplication of tools, jigs, gauges, drawings, and patterns, regrettable though it is, does not end the burden on the Air Service through this variety of designs. The effect, for instance, on the stocks of spares may easily be imagined; the engines are so different in construction that aerodromes at the front not only require separate spares for the several types that are used there, but also have to keep, for purposes of overhaul, separate gangs of mechanics versed in their individual peculiarities. The Production Department that now serves the Air Council in the Ministry of Munitions is well placed for obtaining improvement in the rate of manufacture, but the particulars that have been published of its constitution do not satisfy engineers that it is in a position to use its advantage. So far as is known, the department does not include men on its staff who would be accepted by engineers generally as able to speak with the necessary first-hand knowledge and authority on either the design of internal-combustion engines or the methods

of intensive manufacture. While the Production Department lacks specialised knowledge and authority, even the great abilities of the Director-General will be insufficient to produce the desired results. The duty of manufacturing engineers is to produce the engines, and while the machinery for controlling manufacture remains as it appears to be, it is preventing them from discharging that duty.

FROM the point of view of a statistician and avowedly in the spirit of an iconoclast, Mr. F. J. Brodie considers, in the December issue of *Symons's Meteorological Magazine,* the evidence in respect of the theory as to connection between gunfire and rainfall that can be gathered from the published figures in the weather reports of the Meteorological Office for the three years of the war ended September, 1917. From a series of maps showing the quarterly variation of rainfall with respect to the average for each of the twelve districts into which the British Isles are divided for meteorological purposes, the following conclusions are reached :—(*a*) That over a large portion of the United Kingdom an excess of rain was reported in nine quarters out of twelve; (*b*) that in seven out of the nine wet quarters the excess of rain was greatest in districts situated in the eastern or southern half of the country; further, that in two of the three dry quarters the only districts which failed to report any deficiency were again situated either in the eastern or in the southern section. For the whole period the excess was as much as 26 per cent. in England S.E., 20 in England E., 14 in the Midlands, 10 in England N.E., and 9 in England S.W.; while in Scotland N. and W. there were deficiencies of 5 and 10 per cent. respectively—a suggestive enough distribution. Unfortunately, the figures for northern France and Belgium are not available—the more so since M. Angot, writing in May, 1917, observed that no distribution of excessive rainfall having reference to a centre in the war area had been found in France. It is also worthy of remark that there was, prior to the outbreak of war, every reason for anticipating a continuance of the spell of wet years that had set in, in compensation for the long dry period that marked the nineties of last century and the opening decade of the present century (in London, 1903 was the only wet year between 1894 and 1909); furthermore, that one of the three dry quarters was that of July–September, 1916—the period of a great offensive in Flanders—and that the spring offensive of 1917 also was favoured with fine weather. So long is the arm of coincidence and so infinite are the resources of our climate that, in the absence of valid physical proof, it is doubtful whether, even in the event of similar conditions continuing for another three years (or the duration of the war), meteorologists would be convinced that the "frightfulness" of man can influence the course of the elements.

THE Société d'Anthropologie de Paris bravely continues its work in spite of the war. In part ii. of the *Bulletins et Mémoires* for 1916, which has just reached us, M. R. Anthony contributes a graceful obituary of one of its most illustrious foreign associates, Sir W. Turner. This is accompanied by a full catalogue, extending to nine pages octavo, of the works and papers on anatomy, physiology, and anthropology contributed by him.

MISS M. A. MURRAY supplements her paper in *Folk-lore* (vol. xxviii., No. 3, September, 1917) by an article in the Journal of the Manchester Egyptian and Oriental Society for 1916–17 on "The God of the Witches." She discusses the theory of an Eastern origin of the witchcraft observances, but the evidence is not quite satisfactory. Converts from Islam to the witch cult renounced their old religion, as did the converts from Christianity; Arab witches, like ours, used to ride about on sticks; the name of the great assemblies of the witches, Sabbath, suggests an Eastern origin, but cannot be connected with the sacred day of the Jews. "It seems certain then that in this religion, as in others, there was interchange between the East and the West. But having regard to the antiquity of the witch cult in Europe, it seems to me that the balance of evidence is in favour of its originating in the West, and being carried thence to the East."

IN the *South African Journal of Science* (vol. xiii., No. 11, July, 1917) the Rev. Noel Roberts describes a series of Bushman rock paintings discovered at the Zoutpansberg range, in the northern Transvaal, during the construction of the railway to Messina. The ochre used is believed to be derived from a deposit in the neighbourhood of the caves, and natives assert that the white paint was obtained from the milky kernel of the Stamvruchte (*Chrysophyllum magalismontanum*). Much controversy has arisen regarding the meaning and purpose of the paintings. Some believe that they represent historical incidents, or depict occurrences in hunting. Others trace a connection with the art of northern Africa. But Stow's conclusion that they are purely historical still holds the field. At the same time, as Sir James Frazer has advocated, there may be a magical object, and Mr. Roberts advances some arguments in support of this view. The excavation of the detritus of the caves containing the paintings should bring to light some objects which would help to fix the date and intention of these representations. Meanwhile, the article provides a series of photographs of considerable interest.

MR. C. W. MALLY describes, in the *South African Journal of Science* (vol. xiii., No. 11, July, 1917), a method of destroying that noxious pest, the Argentine ant. The plan is to surround the opening of the nest with a cordon of finely powdered corrosive sublimate about half an inch wide. Under some conditions the ants become excited before they actually touch the powder, the result being probably due to the fact that fine particles of the sublimate are floating in the air. When the drug has been sprinkled on the soil at any point, it remains sufficiently virulent to affect the ants for a long time; some spots thus treated after eight or nine months still react on the ants when they wander over them. Heavy rain disperses the sublimate, but light rain simply carries it into the soil, and then, as the moisture evaporates, there is a tendency for the corrosive sublimate to be re-deposited on the surface. This suggests that the foundations of buildings may be treated, either during or after construction, with a solution which will protect them from ant invasion.

MR. H. H. HAYDEN, Director of the Geological Survey of India, in his report on the earthquake which occurred at Dharmsala on May 10 last, states that the situation of the station, in an area of pronounced tectonic disturbance, renders the occurrence of periodical earth shocks probable. With this possibility in view there are, Mr. Hayden suggests, the alternatives to be considered: either to abandon Dharmsala altogether, or to adopt precautions which may render earthquakes in future, so far as possible, innocuous. The first course he does not recommend, and he believes that precautions such as have been adopted in other parts of the world may render the retention of Dharmsala as a station a matter of comparatively slight risk. He advocates the erection of a new type of building, the houses being either of wood or of reinforced concrete, and he thinks that it would not be difficult to select methods of construction which

would render Dharmsala safe against any earthquake that is likely to occur.

THE problem of mining thin coal-seams has recently been the subject of considerable discussion in Great Britain, and it is interesting to note that it has at the same time been attracting attention in Canada, as is shown by a recent publication of the Canadian Department of Mines, Bulletin No. 15, on the mining of thin coal-seams as applied to the eastern coalfields of Canada, written by Mr. J. F. Kellock Brown. The author discusses the technical aspects of the question, but lays most stress upon its economics. He points out that the present coal industry of eastern Canada is in a weak position, having reached its period of best productivity, but beset with outside competition and rising costs, and operated by over-capitalised concerns, the earning capacity of which is only 3 or 4 per cent. of their capital. He estimates that the coals now being worked may well be exhausted in about a century, and therefore proposes that the industry should be reorganised, worked by powerful corporations or combinations, and that legislation should compel the working of a certain proportion of coal from the thin seams along with that of the more easily wrought thicker seams. He considers that "when properly operated, and properly financed under reasonably favourable conditions, 12-in. seams of coal can be worked economically in eastern Canada to-day," though it is doubtful whether many colliery engineers in this country would fully concur in this conclusion. In any event, the bulletin is an important contribution to the great problem of the proper and effective utilisation of the mineral resources of the British Empire, and deserves careful study from this point of view, as well as for the technical considerations involved. Under the latter head numerous details of machine mining and underground conveyer systems are given, together with the actual operating costs in a few selected examples. The author appears to have reached the definite conclusion that in mining thin seams machine work—not only machine mining, but "the application of power to the whole operation of getting the coal, from the commencement of the undercutting to the placing of the coal into the mine cars"—is essential to success.

PART 3 of vol. vi. of the Science Reports of the University of Sendai, Japan, contains the sixth, seventh, eighth, and ninth reports of the Alloys Research Institute of Japan, which all have reference to the magnetic or other properties of iron and its alloys. The eighth report, by Prof. Honda, deals with the magnetisation of iron powders as the simplest form of the problem presented by the magnetisation of alloys. The powders used were of reduced iron mixed with fine sand to obtain small amounts of iron per c.c., and compressed to get densities approaching that of solid iron. Rods of 0·5 cm. diameter 15 cm. long were magnetised in a coil, providing fields up to 1000, and the magnetisation measured ballistically. The curve showing the relation between the specific magnetisation (the quotient of the intensity of magnetisation by the mass of iron per c.c. of the specimen) of the solid iron is of the usual type, the bend or shoulder occurring between fields 50 and 200, and the saturation value of the specific magnetisation being 210. For a powder containing three-fourths the iron per c.c. the curve shows no shoulder, though it is convex upwards. At a field of 1000 its specific magnetisation is only 140, and shows no sign of saturation. For smaller quantities of iron per c.c. the curves become nearly straight lines—that is, the specific magnetic susceptibility becomes constant for each mixture, but decreases as the mixture contains less iron.

THE latest list of Mr. F. Edwards, 83 High Street, Marylebone, W.1 (No. 380), contains 1066 items, and is devoted to biography. It is not very strong in science, but among the books offered for sale we notice the memoir of "Sir Samuel Baker," by T. Douglas Murray and A. Silva White; "Sir Joseph Banks's Journal during Capt. Cook's First Voyage," edited by Sir J. D. Hooker; "Life of Sir Joseph Banks," by E. Smith; the first edition of Washington Irving's "Christopher Columbus: History of his Life and Voyages"; "Charles Darwin: Life and Letters," edited by Sir F. Darwin; "Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton," by Sir D. Brewster, and several lives of men of science which have been published during the past few weeks. The catalogue will be sent upon written application.

MR. W. HEINEMANN will shortly publish vol. ii. of Dr. Montessori's "The Advanced Method." The work will deal with the Montessori material, and the use of it, for children up to the age of eleven years, and will be illustrated. It is announced in connection with the volume that an authorised Montessori Training Institute is to be established in this country, presided over by Dr. Montessori.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET.—Encke's comet, which has been observed at every perihelion passage since 1819, has once more been detected, the discoverer being Prof. Schorr, at Bergedorf, Hamburg. The position on December 30 at 5h. 27m. G.M.T. was R.A. 22h. 59m. 4·93s., N. declination 3° 17′ 35″. The comet was of the 15th magnitude, but should brighten considerably in the next few weeks. The observed R.A. was smaller than the tabular by 4s., the declination smaller by 40″. These small residuals indicate that Mr. Viljev's calculated time of perihelion passage 1918 March 24·3 G.M.T. is not much in error, perhaps about 0·2d. too late. This adds certainty to Mr. Viljev's conclusion that the object observed in September and November, 1916, was not the comet. An ephemeris was given in NATURE of December 27.

THE NEAREST STAR KNOWN.—In Circular No. 40 of the Union Observatory, Mr. Innes gives the results of observations made for the determination of the parallax of the interesting faint star near α Centauri to which he first directed attention about two years ago. The observations extended from May 26, 1916, to August 23, 1917, and were made with a micrometer attached to the 9-in. equatorial at Johannesburg. The resulting value for the parallax is 0·88″, as compared with 0·755″ recently determined at the Cape Observatory by Mr. Voûte. The mean of the two values is 0·82″. The largest parallax previously known is that of α Centauri, which Kapteyn gives as 0·759″, and it would thus appear that the Innes star is the nearest known star to the solar system. The proper motion of the faint star is closely similar, in both magnitude and direction, to that of α Centauri, notwithstanding the separation of 2° 13′. Mr. Innes suggests *Proxima Centaurus* as a convenient name for this small star. The visual and photographic magnitudes of the star are 11 and 13 respectively.

THE INTERIOR OF A STAR.—An interesting popular account of his mathematical investigations relating to the physical conditions in the interior of a star is given under this title by Prof. A. S. Eddington in *Scientia* for January. Prof. Eddington considers that there is now overwhelming evidence in favour of the existence

of stars of increasing, as well as stars of decreasing temperature, as has so long been advocated by Sir Norman Lockyer. Chiefly through the work of Hertzsprung and Russell, it has, in fact, been found that many well-known stars are in a highly diffuse state, and when such stars contract under the influence of their own gravitation, they must rise in temperature until they cease to approximate to perfectly gaseous conditions (density 0·2 to 0·4 compared with water). Prof. Eddington has made an important modification of Lane's theory by taking account of radiation-pressure, and he shows that as a star contracts the diminishing surface is compensated by increasing radiation, so that the total radiation remains nearly constant, until the density becomes too great for the theory to apply. Afterwards the star passes to the descending branch of the temperature curve, and the total radiation falls off very rapidly. Radiation-pressure has further been found to provide a reasonable explanation of the approximate uniformity of stellar masses.

THE VISCOSITY OF SLAG AT HIGH TEMPERATURES.

ALTHOUGH the data which have in recent years been accumulated on the behaviour of silicates at high temperatures possess a great interest and value from the points of view of the mineralogist and the geophysicist, a knowledge of the melting points and fields of stability of the silicates is not the most important factor for consideration in so far as application to the metallurgy of iron is concerned. In a study of the blast-furnace process what is of particular interest is the behaviour of the slag from the time it enters the zone of fusion until it is flushed from the slag-notch. In passing through this region where the smelting process occurs the most important *physical* property of the slag is its viscosity, while its most important *chemical* property is its desulphurising power.

It has long been known to furnacemen that molten blast-furnace slag is much more viscous than molten iron and most fused salts, and that the slag undergoes a gradual softening on heating rather than a sudden change to a mobile liquid. This particular characteristic was from the first rightly attributed to the silica content of the slag, and it appears to be due to the nature of the molecule, SiO_2, rather than to the element silicon itself. X-ray analysis in the hands of Prof. W. H. and Mr. W. L. Bragg has furnished an important confirmation of this hypothesis. Instead of finding, as is the case with the crystals of most chemical compounds, that the atoms are arranged separately at definite points of a space-lattice, they concluded that *three silica molecules* are associated with each point of the space-lattice. It is a matter of common knowledge that highly associated or polymerised liquids possess unusually high viscosity, and hence it seems plausible to argue that, since silica appears to be unusually complex in the solid state, this association or polymerisation tendency must be the fundamental cause of the extreme viscosity of silica itself and the high viscosity of the silicates in the liquid state. When a silicate gradually softens with rising temperature and passes entirely over into the liquid state it is probable that the increased fluidity is due to a weakening of the "residual-valence" attraction between the group-molecules, while the relatively high viscosity of the melt, as compared with that of molten metals and ordinary salts, is due to the preponderance of the group-molecules silica, alumina, and lime, and possibly in a particularly large degree to a highly polymerised condition of the silica group-molecule.

Considerations of this kind are set out in a valuable paper by Mr. A. L. Feild, assistant metallurgist at the United States Bureau of Mines, in a recent paper presented to the Faraday Society.[1] Mr. Feild points out that while it is theoretically possible to render any silicate mixture whatever sufficiently fluid to flow from the slag-notch of a blast-furnace it is necessary in practice that the slag should attain this necessary fluidity at a temperature which is not beyond the working limit of the blast-furnace lining, and does not demand an unusually high fuel consumption. It is obvious that if, for instance, a slag requires a minimum temperature of 1400° C. in order to attain a working fluidity, no iron will be produced in a furnace using this slag, regardless of the number of B.Th. units developed within the furnace, unless the temperature distribution is such that the slag acquires the necessary temperature at 1400° C. *Thus the fuel economy of the blast-furnace is to a great extent dependent upon the temperature-viscosity relations of the slag.* Apart from the question of mining cost and freightage, the value of an iron ore sufficiently rich in iron to be considered marketable largely depends on whether it can be made to yield economically a slag of desirable viscosity and desulphurising power.

Mr. Feild has worked out a method of determining the viscosities of slags up to 1600° C., this limit being imposed by the furnace refractories and not by inherent limitations of the apparatus. He has used a modification of the method originated by Margules in 1881, in which the liquid is confined between two concentric cylinders. The outer cylinder is rotated at a constant speed, and the torque exerted upon the inner cylinder measured. The method is applicable to liquids of a wide range of viscosity, and has been applied in this case to measurements on slags over a range of viscosity from 200 to 3000 (water at 20° C. = 1). Acheson graphite was used in the construction of all parts subjected to high temperatures, and the suspended system was damped so as to give it the stability and aperiodicity of the familiar damped D'Arsonval galvanometer. The outer cylinder was rotated about a vertical axis at a constant speed. The inner cylinder was suspended coaxially within the outer one by means of a steel or phosphor-bronze ribbon. Experimental data derived by this method are capable of an easy direct mathematical interpretation. A cylinder of radius b, rotating with a constant angular velocity ω, will exert upon an inner fixed concentric cylinder of radius a—the space between them being filled with the liquid—a couple Γ given by the relation

$$4\pi\eta L\frac{a^2b^2}{b^2-a^2}\omega,$$

where η is the coefficient of viscosity and L the common length of the two cylinders. With cylinders of fixed dimensions the viscosity is proportional to the torsion couple and inversely proportional to the speed of rotation in revolutions per second. Conversely the torsion couple is proportional to the speed of rotation and to the viscosity.

Viscosity values are given for eight commercial slags, two synthetic slags, and an artificial diopside. The temperature-viscosity curve approximates in form to that of the rectangular hyperbola, while the temperature-fluidity curve approaches a straight line in form. The average viscosity at 1500° C. of eight commercial slags was found to be 301 (water at 20° C. = 1). Refractory slags have been found to be not necessarily more viscous at high temperature than more fusible ones.

H. C. H. C.

[1] "The Viscosity of Blast-furnace Slag and its Relation to Iron Metallurgy, including a Description of a New Method of Measuring Slag Viscosity at High Temperatures." Proceedings, December, 1917.

THE LEARNING PROCESS IN A SNAIL.[1]

In his well-known experiments (1904), the Russian physiologist Pavlov showed that salivary secretion in a dog, primarily induced by the odour or sight of food, could eventually be induced by a sound or colour which had been for a time synchronised with the primary stimulus. The dog, according to the experiments, was soon able to establish an organic association between the primary and the secondary stimulus. When Pavlov slightly changed the secondary stimulus there was a change in the dog's salivary reaction, and this was taken as evidence of the animal's power to discriminate between stimuli.

With noteworthy clear-headedness, Miss Elizabeth Lockwood Thompson has seen how to apply Pavlov's method to a water-snail, *Physa gyrina,* which glides about in ponds, with foot and mouth upwards, suspended from the surface-film. When a part of the body within a millimetre or two of the mouth is touched with a bit of food, a chewing motion of the mouth-parts is started. With the application of food to near the mouth there was synchronously associated a pressure with a clean glass rod at a fixed distance from the mouth. The next step in the ingenious experiment was to apply the associated or auxiliary stimulus alone in the absence of food, in order to determine from the presence or absence of reactions whether or not an association had been formed between the two sets of stimuli. Miss Thompson deserves to be congratulated, we think, on this extension of Pavlov's method, which he himself did not regard as applicable, except to a limited number of mammals. It is now possible, along this line of investigation, to test a snail's power of "learning."

When food was applied to the mouth and at once withdrawn, response followed in 61 per cent. of the tests, the mouth being opened and closed on an average 3·93 times. By means of an apparatus a simultaneous application of pressure to the foot and food to the mouth was secured. In the first 60–110 trials of simultaneous stimuli no response followed; in the remaining trials, out of 250 in all, a response was always given. The snails were thus "trained." After forty-eight hours a response followed the pressure by itself, *i.e.* in the absence of any food-stimulus, but only for a limited period. Cessation of response to pressure after training is sudden and final. The limit of the effect of training (which simulates memory) is about ninety-six hours. An interesting waning of response (marked by a reduction in the number of mouth movements) was observed in some series of trials; it showed that the snails became adapted to a stimulus which was not followed by its wonted reward. The relation between length of training and training effect (as measured by response to pressure only) requires further investigation.

Miss Thompson also devoted many experiments to inquiring whether the snail could learn to solve a simple U-shaped or Y-shaped labyrinth with a picket fence of wires, one arm leading from near the foot of the tank to the air (the reward), the other not (the punishment). In some cases error was punished by an electric shock, and roughness of the path was used as a warning stimulus. The result was interesting. The snails showed no ability to learn that the one path was to be preferred to the other. But in 15 per cent. of a total of 030 trials in one series, the snails changed their course from the wrong to the right path after contact with a warning stimulus (in this case, slight irritation of the tentacles and the back of the head with a hair) before the shock (punishment) was received. There was formed a weak association between two stimuli, the hair and the shock, the former serving as a warning of the punishment to follow if the course be not changed. But the capacity to form associations, already proved by the method of using simultaneous stimuli, does not suffice for the solution of the simplest labyrinth. There was no evidence of "selective" ability.

Miss Thompson has made a very interesting contribution to the study of animal behaviour; the details of the experiments show the punctilious carefulness of her work.

[1] "An Analysis of the Learning Process in the Snail, *Physa gyrina*, Say." (Behaviour Monographs, vol. iii., No. 3, 1917, pp. 1–89+8 plates+12 tables.) (Cambridge, Mass.)

SCREW GAUGES.

The production of a satisfactory screw gauge is a matter of considerable difficulty as regards both manufacture and testing, and the pamphlet on this subject just issued by the National Physical Laboratory[1] will be found to contain much useful information.

In the case of a plug screw gauge, it is essential that it should enter a standard check ring gauge, but this test is insufficient, since it may be complied with by a plug gauge having such a combination of errors as to enable it to enter the check and yet be useless for the purpose of gauging screws. "Not go" tests are also essential, and certain errors can be detected only by carrying out measurements on the gauge of either a mechanical or an optical character. The full (or major) diameter is measured by use of a micrometer in conjunction with a set of Hoffmann roller gauges. The core (or minor) diameter and the effective diameter are also measured by means of a micrometer, together with a pair of Vee-pieces and a pair of small cylinders respectively. The lathe in which the gauge is machined should be furnished with an attachment for holding the micrometer so that its axis intersects the axis of the gauge at right angles, and arranged so that the instrument can be readily removed. This permits of the gauge being measured as the work proceeds, without the necessity for removing it from the machine. In instruments used for measuring these diameters in the inspection room, the micrometer should be held mechanically so as to comply with the same condition.

The machine described in the pamphlet for measuring the pitch of the screw appears to be both simple and effective. The actual measurement is made by means of a micrometer having a large dial reading to 0·0001 in. An ingenious arrangement, partly mechanical and partly optical, ensures that the axial movement of the micrometer point shall be exactly equal to the pitch of the screw under test. Both periodic and progressive errors in the pitch can be detected from the readings obtained in this machine.

As a general rule, optical measurements of screw gauges cannot be made to the same accuracy as mechanical measurements, but optical methods are of great service from the consideration that the whole of the screwed surface of a gauge can be examined in detail. Errors in angle, want of straightness of the threads, eccentricity between different diameters, and local bumps and hollows can be detected readily by optical means. Until recently, microscopes having cross wires in the eyepiece were alone employed for measurements, and a machine embodying this principle is made by the Cambridge Scientific Instrument Co., and is described in the pamphlet. Such methods have now been displaced to a great extent by a pro-

[1] "Notes on Screw Gauges." By the Staff of the Gauge-testing Department, National Physical Laboratory. Enlarged issue II. (Teddington: W. E. Parrott, The Causeway, 1917.) Price 2s. 6d.

jection machine, which throws on a screen a shadow-like image of the screw thread, magnified a definite number of times. This image is then superposed on a diagram of the correct thread form, drawn to the same magnification. Thus variations from the true form can be seen and measured with a scale. A simple projection apparatus and another having a large field of view are described, together with some convenient accessories.

With the exception of core diameter and pitch, the elements of a screw ring gauge cannot be measured readily. The method of taking plaster casts has been tried, but such casts cannot at present be relied upon to nearer than ±0·0005 to ±0·001 in. In general, screw ring gauges are not measured, but tested between limits by "go" and "not go" check plugs, made so as to test each diameter independently.

The pamphlet is written in a very practical manner, and sufficient information and drawings are given to enable anyone interested to set up the various appliances for himself. We are also glad to note that manufacturers who contemplate the installation of measuring instruments, or have experienced difficulties in measurement, are invited to visit the laboratory by appointment to discuss their particular problems with the members of the staff.

MARINE BIOLOGY.

THE twenty-fourth report (1916) of the Danish Biological Station contains two papers of much interest to marine biologists. Dr. C. G. J. Petersen gives a useful account of the development of the external characters in three of the common species of Gobius. The great difficulty there is in discriminating between the young stages of these fishes is well known to those who have handled general collections made in European waters, and Dr. Petersen's careful descriptions will be much appreciated. The second paper in the report is by Dr. H. Blegvad, on the food of fishes in Danish waters within the Skaw. The new feature in this work is that, in addition to an account of the kind of food upon which each species was found to be feeding, the weight of each kind of food found in the fish and the weight of the fish itself were recorded. In this way a more accurate idea of the relative importance of the different kinds of food can be obtained.

In the Marine Biological Report, No. iii., 1916, for the province of the Cape of Good Hope, Dr. J. D. F. Gilchrist, in the first paper, describes the eggs and larvæ of a number of Cape fishes. Unfortunately the figures which accompany this paper appear to have lost a great deal in the reproduction, and many of them can scarcely be considered adequate for recognising these very delicate forms, the identification of which often depends on a correct representation of their minute details. The remainder of the report contains an account of some observations on marine invertebrates, made on animals living in the tanks of the Marine Station at St. James, the description of four new South African fishes, which are well figured, and a continuation of Mr. W. Wardlaw Thompson's "Catalogue of Fishes of the Cape Province," with a very full bibliography of each species.

THE DEVELOPMENT OF BRITISH AGRICULTURE AND FISHERIES.[1]

THE advances recommended during the year amounted to 334,903*l.* Since the commencement of the war advances from the Development Fund have been mainly confined to schemes already established with the expectation of continued help from the fund, for which just sufficient advances have been recommended to secure continuity.

As regards new schemes, the Commissioners have continued to recommend expenditure upon the preparation, by way of preliminary surveys and reports, of projects of development for commencement after the war when the employment of labour upon a large scale may be desirable. They have also recommended expenditure on certain new schemes in order to meet war conditions, particularly in connecton with food supply and natural products. The two most important new advances recommended by them during the year, namely, 125,000*l.* for purchase of an estate for sugar-beet growing, and 50,000*l.* for improving the fish food supply by installing motors in fishing-boats in England and Wales, fall under this heading. These two advances amount to one-half of the whole sum recommended for the year. A largely increased supply of plants for afforestation purposes, and increased growings of flax for aeroplane cloth, are other instances where war conditions have called for extra expenditure from the Development Fund.

AGRICULTURE AND RURAL INDUSTRIES.

Agricultural Research and Education, etc.—For the continuance of the research scheme in England and Wales during 1917–18 the following grants from the Development Fund to the Board of Agriculture and Fisheries have been sanctioned:—

Grants to colleges and institutions in aid of—	£
(*a*) Scientific research and experiments ...	19,600
(*b*) The extension of advisory and local investigation work	8,000
(*c*) Special investigations and research, and scholarships	2,400
(*d*) Inquiries and experiments, etc., by or on behalf of the Board	600
Expenses of administration	880
	31,480
Less amount not payable from the Development Fund	1,750
	29,730
Research in animal pathology to be undertaken at the Board's veterinary laboratory, 1917–18	2,000
Research Institute in Plant Pathology at Kew	1,358

The proposed expenditure in respect of the grants for research institutes and advisory centres contemplates only the carrying on of existing work, and no new work of any importance was started last year with the exception of investigations bearing directly on the war, with which some of the workers are engaged, particularly at Cambridge University.

A grant to the Board of Agriculture and Fisheries of 16,445*l.* was made in aid of agricultural and dairy education during the year 1917–18.

A grant of 3700*l.* was sanctioned to enable the Board in consultation with the Commissioners to assist new emergency schemes of an educational or quasi-educational character. A grant of 1330*l.* was made to the Imperial College of Science and Technology for an investigation during 1917 into the effect of electrical discharge on the growth of crops.

The Commissioners have recommended an advance of 400*l.* to the North of Scotland College of Agriculture for the continuation during 1916–17 of research work which is being carried out under the supervision of a joint committee of the University of Aberdeen and of the college; an advance of 315*l.* to the University of Edinburgh for the continuation during the period

[1] Abstracted from the seventh report of the Development Commissioners on their proceedings during the year ended March 31, 1917.

November, 1915, to November, 1917, of research in animal breeding; and advances of 700*l.* and 395*l.* to the Board of Agriculture for Scotland for the purpose of aiding the University of St. Andrews and the three agricultural colleges of Scotland in carrying out during the academic years 1915–16 and 1916–17 schemes of special research in agricultural science. The Commissioners also recommended the renewal in respect of 1916–17 of the annual advance of 5000*l.* in aid of "extension" work at the three Scottish agricultural colleges—*i.e.* instruction to agriculturists in the colleges' provinces.

For the year 1917–18 a grant of 4000*l.* was made to the Department of Agriculture and Technical Instruction for Ireland in aid of its scheme of technical and advisory work in connection with agriculture, and a grant of 196*l.* in aid of the maintenance of property acquired for a new veterinary research laboratory.

Eggs and Poultry.—A grant to the Board of Agriculture and Fisheries of 3200*l.* was recommended for a scheme for augmenting the production of eggs and poultry during the season 1916–17 by the establishment of 300 centres in England and Wales for the distribution of trustworthy eggs for hatching, twenty stations for the distribution of day-old chicks, and the provision of five incubating stations; and a grant of 358*l.* to the Utility Poultry Club in aid of the continuance of the Burbage breeding experiments during the year to September 30, 1916.

Cultivation and Preparation of Flax, Hemp, and Tobacco.—Two grants to the British Flax and Hemp Growers' Society were recommended: one of 4575*l.* to meet the expenses of the society during the six months to September 30, 1916, and the other of 6275*l.* to meet the expenses of the society during the year to September 30, 1917. The object of the society is to ascertain whether flax can be grown in this country with profit to the growers. The society's scheme involves the cultivation of flax in selected districts, the establishment of experimental retteries, experiments on the growth of flax as a crop for seed independent of fibre, and experiments in the breeding and selection of better strains of flax. Owing to the war and the consequent rise in the price of flax, the acreage has been increased, and it is expected that the enhanced prices will cause a considerable reduction in the cost to the Development Fund of these experiments and at the same time stimulate the revival of the industry in this country. Shortly after the close of the year to which this report relates the Commissioners recommended a supplementary grant for a considerable extension of the society's work in 1917, undertaken partly in order to ensure a future supply of material for the production of aeroplane cloth and partly to increase the growth of linseed as a feeding stuff for stock.

A grant of 1200*l.* to the British Tobacco Growers' Society was recommended for the continuance of the work of the society during the year 1916–17. The society is conducting experiments in the cultivation and preparation for market of tobacco and nicotine products in order to ascertain whether tobacco can be grown in this country with profit to the grower. Confidence in the possibilities of the tobacco crop was so far established as to enable the society for the first time in 1915–16 to make contracts with growers to grow the tobacco at their own risk and at a fixed price, with the stipulation that only sound saleable leaves would be accepted. The arrangements proposed for 1916–17 are an advance in the experimental stage. The Commissioners considered the question of the suspension of the society's work until the end of the war, but the society claimed that the experiments had reached a stage at which their abandonment or suspension would involve a serious loss of the value of all past expenditure, and a largely decreased grant was applied for to carry on the work. The Commissioners came to the conclusion that a case had been made out for the limited operations proposed.

Encouragement of a Beet Sugar Industry.—The Commissioners are of opinion that a trial on a considerable scale of a sugar beet experiment should be made, and that the present time affords particular reasons for initiating such a trial. The Kelham Estate, Nottinghamshire, is exceptionally suitable for such an experiment, and the Commissioners recommended a loan of 125,000*l.* for its purchase with a view to the establishment of the beet sugar industry in this country.

Horse and Live Stock Breeding.—The following grants were recommended:—

35,100*l.* to the Board of Agriculture and Fisheries to meet the cost during the year 1917–18 of the scheme for the improvement of heavy horses, cattle, and swine, the extension of milk recording, and the employment of live stock officers at agricultural institutions in England and Wales; 10,250*l.* to the Board of Agriculture for Scotland in aid of the scheme for the improvement of heavy horses and cattle, and the extension of milk recording in Scotland during the year 1917–18; and 2000*l.* to the Department of Agriculture and Technical Instruction for Ireland in aid of the Department's scheme for the improvement of Irish draught horses during the year 1917–18.

Organisation of Co-operation among Agriculturists.—A grant to the Agricultural Organisation Society of England and Wales for its work during the year 1916–17 was recommended; also a grant to the Scottish Agricultural Organisation Society in aid of its work during 1916–17, consisting of an advance equal to the amount spent from the society's own funds during the year, but not exceeding 1000*l.*; and a grant of 5320*l.* to the Irish Agricultural Organisation Society in aid of its work during the year 1916–17.

FORESTRY.

During the year the Commissioners reviewed their policy with regard to new forestry schemes to be financed from the Development Fund, especially in relation to the alternatives of purchase and long lease of land, and to their proposals for afforesting privately owned land on the basis of a division of the proceeds when they accrue. The experience of the war has shown that the nation must in prudence be prepared to incur substantial expenditure in increasing the home-grown supplies of timber. Much of the waste land of the country can be turned to account only by putting it under timber; and there are other areas of unimproved land which can be rescued from their present unproductive condition by composite schemes of afforestation and reclamation. A forest will afford seasonal employment for men occupying or employed on small farms, and will itself be economically worked by the labour so employed.

A grant of 4300*l.* to the Board of Agriculture and Fisheries was recommended for the continuation in the year 1917–18 of the scheme for research, forestry instruction and advisory work at four centres in England and Wales, minor forestry experiments and surveys. It was represented to the Commissioners by the Board of Agriculture that in view of the large amount of timber which was being cut down in this country, the difficulties in which nurserymen were involved owing to the shortage of labour, and the fact that seed and seedlings of enemy origin, largely purchased in normal times by nurserymen, were no longer available, it was desirable to raise a supply of forest tree seedlings in case there might be a shortage for replanting after the war. A grant of 200*l.* was made

to the Commissioners of Woods towards the cost of the maintenance of the Forest of Dean Demonstration Area during 1916–17, on the condition that the land revenues of the Crown should continue as hitherto to bear the cost of general improvements and maintenance of Dean Forest and adjoining woodlands.

A grant of 1000*l.* for 1917–18 was recommended for the salaries and expenses of three forestry officers for advisory, survey, and research work, one at each of the three Scottish agricultural colleges.

During the year the Commissioners have reviewed the terms on which advances from the Development Fund have been made or promised for the purchase of land in Ireland and its afforestation. A provisional agreement was reached between the Commissioners and the Department of Agriculture, and in March last the revised terms were submitted for the approval of the Lords Commissioners of the Treasury.

DEVELOPMENT AND IMPROVEMENT OF FISHERIES.

The development of sea fisheries and the increase of the fish food supply have been among the most important of the matters for which advances have been made during the year. The following advances for these purposes have been sanctioned, viz.: In January, 1917, an advance not exceeding 50,000*l.* to the Board of Agriculture and Fisheries for the provision of motor-power in fishing-vessels in England and Wales. The administration of this advance is in the hands of a small central executive committee appointed by the Board in consultation with the Development Commission. Not the least part of the Committee's work has been that of arranging for the necessary fuel, boxes, and other fishing supplies. During the time that this scheme has been in operation the results obtained have been satisfactory, and they promise to prove still more fruitful in the future. In January, 1917, an advance not exceeding 2000*l.* to the Cornwall Sea Fisheries Committee to enable fishermen at the Mount's Bay Ports and St. Ives to instal mechanical power in their boats. In March, 1917, authority was given for the unexpended balance of the grant of 2000*l.* to the Devon Sea Fisheries Committee for the purpose of experiments with motor-power in trawlers, etc., to be used in making loans to fishermen to enable them to instal motors in their boats. The unexpended balance in question was about 1900*l.*

An advance of 510*l.*, the available balance of the sum of 3000*l.* originally made applicable for the development of motor-boat fishing in Ireland, was sanctioned for the same purpose during the year 1917–18.

For the purposes of fishery research in 1917–18 a grant of 675*l.* was sanctioned, being 250*l.* less than the amount sanctioned for 1916–17. This sum was to be allocated by the Board of Agriculture and Fisheries, when the nature of the work had been definitely settled, between the following institutions: The Marine Biological Association, the Lancashire and Western Local Fisheries Committee, Liverpool University, University College of Wales, and the Armstrong College, Durham.

FINANCE OF THE DEVELOPMENT FUND.

The total sum guaranteed to the fund is 2,900,000*l.*, which has all been paid over; in addition, interest on investments and other receipts up to March 31, 1917, amounted to 390,000*l.*, a total of 3,290,000*l.*

As will be seen from the table below, the total advances recommended to March 31, 1917, amounted to 2,602,277*l.* This sum cannot, however, be taken as the effective demand upon the fund: some of the recommended advances included in earlier schedules were not ultimately sanctioned by the Treasury, and in the case of several schemes for which assistance is sought annually the amounts sanctioned were not wholly spent within the year for which the grants were sanctioned.

The Commissioners estimate that the effective total of the advances sanctioned up to March 31, 1917, amount approximately to 2,085,000*l.*, leaving therefore a balance of 1,205,000*l.* then available to meet recurrent annual grants for existing schemes, new projects, and for an emergency programme of development works which is being prepared as suitable to be started at the end of the war.

Summary of Recommendations, 1916–17.

	Grant. £	Loan. £
Agriculture and rural industries ...	139,348	125,000
Forestry	15,676	—
Reclamation and drainage of land ...	850	—
Harbours	844	—
Fisheries	51,185	2,000
	207,903	127,000
Total	334,903*l.*	

Sum Total of Advances Recommended up to March 31, 1917.

	Grant. £	Loan. £
Agriculture and rural industries ...	1,492,172	128,500
Forestry	101,833	153,411
Reclamation and drainage of land	6,565	4,000
Rural transport	—	80,000
Harbours	214,539	171,410
Inland navigations	—	109,500
Fisheries	109,297	30,250
Sea defence works	—	800
	1,924,406	677,871
Total	2,602,277*l.*	

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

UNDER the auspices of the Council of the Library Association, the Athenæum Press has issued a Subject Index to Periodicals for 1916, the Historical, Political, and Economic Sciences, including the European war, geography, anthropology, and folklore. The catalogue is well arranged, and contains a wide survey of periodical literature. Owing to the high cost of printing and paper, the list of periodicals cited has been omitted, but in the present list 305 publications are indexed. The present catalogue can be regarded as only tentative, the Proceedings of some societies being in arrear, and most of those from the Continent unprocurable. But the idea is good, and in quieter times the catalogue will be more comprehensive.

AT the annual meeting of the Headmasters' Association, Mr. A. P. M. Fleming (British Westinghouse Electric and Manufacturing Co.) gave an address on the increasing part which democracy would play in the near future in industry and public life. He said that industrial progress had been greatly accelerated in some directions, but that unity of aim and purpose among industrial workers was essential to continued advance. Industrial progress was incompatible with industrial unrest, and teachers should put industrial problems before their pupils in the right way, thus contributing to their right solution. Industrial harmony must be based on a sense of justice and of individual responsibilities as well as of individual rights.

A course of nine lectures on "The Practical Applications of the Study of Weather" has been arranged and will be given at the Meteorological Office, by Sir Napier Shaw, on Fridays at 3 p.m., beginning on January 25. Each lecture will be followed by a conversation class for the discussion of practical details. The fortnightly meetings at the Meteorological Office for the discussion of contributions to current meteorology in colonial or foreign journals will be resumed at 5 p.m. on Monday, January 14, and will be continued on alternate Mondays until March 25. Students wishing to attend should communicate with Sir Napier Shaw at the Meteorological Office. The lectures are for advanced students and others interested in the subject. Admission is free, by ticket, to be obtained on application at the Meteorological Office, South Kensington, S.W.7.

The University of London has arranged for the second term of the current session a series of public lectures in Imperial studies. A course of ten lectures on some biological problems of to-day will be given at University College, Gower Street, beginning on January 21, at 4 p.m., when Prof. W. M. Bayliss will lecture on the problem of food. Lectures will be given on future Mondays on other problems by distinguished authorities in biology. At King's College, Strand, and at King's College for Women, nine lectures on animal life and human progress will be given at 5.30 p.m. on the Wednesdays beginning January 30, when Prof. Arthur Dendy will take for his subject "Man's Account with the Lower Animals." In later weeks lectures on other matters of biological importance will be given by other well-known zoologists. Seven public lectures on "The Empire: its Commerce and Commercial Requirements," will be delivered at the London School of Economics, beginning at 5 p.m. on January 18, when Sir Alfred D. Hall, K.C.B., will speak on artificial manures.

The Association of Science Teachers held its annual business and open meetings in connection with the Education Conference at University College, London, on January 3. At the business meeting a project was discussed for starting branches of the association in various parts of the country, and a committee was elected to draw up a scheme. A resolution was passed, and forwarded to the Headmistresses' Association, urging the necessity for allotting more time to science in girls' schools, and suggesting that physics be made the basic science. The growing tendency to limit the science in girls' schools to little more than botany was deprecated. At the open meeting, both the address from Prof. Davidge, of the Ordnance College, Woolwich, and the discussion in the afternoon opened by Prof. Womack, dealt with physics. Prof. Davidge described field telephones used on the battlefield, and exhibited a visible buzzer similar to one captured from the Germans, which solved the problem of the "ring-off" in the trench exchange. His audience was interested in what he had to say of the ignorance of science among men who came to him at the Ordnance College, an ignorance which suggested that the "fairy-tales of science" have not been making a wide appeal. Prof. Womack dealt with the teaching of physics in girls' schools. He advocated humanistic treatment; mechanics, which he considered specially important, should not be treated as a mathematical subject, but experimentally, with direct reference to the environment. In the discussion which followed, the views of Prof. Womack were supported by Miss Lees and other science teachers in girls' schools.

One serious omission in most recent schemes for educational reform is the absence of any proposal for ascertaining what educational facilities are at present in existence. Similarly, in Mr. Fisher's Bill the local authorities when preparing schemes of educational organisation are instructed to consult with other local education authorities, but no mention is made of autonomous institutions, such as private schools. Yet the various types of private schools and cognate institutions provide for a large number of boys and girls, and a recognition of this fact is important for many reasons. Lady Napier Shaw has therefore done good service by directing attention in the December number of the Journal of the British Science Guild to the need for a register of all existing schools. She gives the text of a draft Bill which has been considered by the Guild, intended to secure the formation and maintenance of a register of all colleges and schools in England and Wales, giving particulars of their constitution, staffs, pupils, accommodation, and provision for recreation. This draft Bill differs from Clause 24 in Mr. Fisher's Bill in that it provides that each education authority shall compile its own register, which is then to be forwarded to the Board of Education. Further, schools are to be induced to register by the denial to unregistered schools of the right to recover fees from pupils, and by the liability of such pupils to be proceeded against under the Compulsory Education Act. No one knows at present how many schools there are in England or how many of them are reasonably efficient, and some such measure as that proposed by Lady Shaw is urgently required. We ought to know the relevant facts before proceeding to take action.

Our readers will remember that in the summer of 1915 the University College of Wales, Aberystwyth, became the possessor of the library and lifelong collections of the late F. W. Rudler, who was professor and dean of the college in the years 1876–80, and afterwards became curator of the Museum of Practical Geology, Jermyn Street, London. His library, consisting of about 2000 volumes and 4000 pamphlets, has been tabulated and cross-indexed, and his extensive collection of rocks, fossils, etc., carefully labelled. The mineralogical collection has been made available for teaching and demonstration purposes, while the archæological and other specimens have been added to the college museum. The additions thus made to the college collections, further assisted by the foundation of the "F. W. Rudler Geological Research Scholarship," have greatly increased the facilities for research work, particularly in the subject of geology. M. Jules Bernaerts, the eminent Belgian sculptor (of the Royal Academy of Brussels), has executed a life-size medallion of Prof. Rudler, which has been framed in oak and placed in the wall of the college quadrangle, and below it a brass tablet bearing the inscription:—"In memory of F. W. Rudler, I.S.O., F.G.S., 1840–1915. Professor in this College 1876–80, and Founder of the College Museum," has been affixed to a polished slab of Welsh marble specially cut for the purpose from the Narberth Quarries, Pembrokeshire. Prof. Rudler's numerous friends and all concerned in the welfare of the college will be pleased to know that the collections which he formed with so much ability have thus been made available for the furtherance of those studies in which he was so deeply interested, and to which he devoted the labours of a lifetime.

At the annual meeting of the Geographical Association the president, Sir W. M. Ramsay, gave an address entitled "The Great Goddess Mother Earth," and as arising out of it various speakers from the Classical and Geographical Associations urged the closer co-operation of these mutually complementary lines of teaching and research. It is hoped that the classical geographers will be studied afresh, and that new in-

sight into the history of civilisation may be gained by combination of the points of view. The annual lecture was upon the crafts of Britain, past and future, and in it Mr. Henry Wilson, president of the Arts and Crafts Society, pleaded with geographers for spiritual maps, maps of the spread of forms of spiritual expression in handwork, maps of the spread of ideas and enthusiasms. In this way, the lecturer urged, we should work effectively towards a genuine revival of folk-life and of taste and creative power that would go with it. Mr. W. E. Whitehouse (University College, Aberystwyth) opened a discussion on map-reading as an element in both geographical and military education, and gave the results of his experience in training O.T.C. cadets and teachers. A session was devoted to papers sketching advanced courses for pupils in secondary schools (sixteen–eighteen), and the association's view was strongly expressed that an attempt must be made to diminish the separateness of the faculties of study. It would be highly desirable to have an "advanced course," including history on one hand and science on the other, and pivoting upon geography as essentially the regional study of human experience. The association is glad to be authoritatively assured that a course planned on these lines would receive sympathetic consideration from the Board of Education whatever the wording of the present regulations.

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, December 12, 1917.—Mr. W. R. Bousfield, vice-president, in the chair.—Prof. A. W. **Porter**: The thermal properties of sulphuric acid and oleum. The object of this paper is to supply data at various temperatures for the heats of solution and dilution and evaporation, both of sulphuric acid and oleum. Pre-existing data apply only to atmospheric temperatures; but technical processes take place at various temperatures up to 200° C. or above. These additional data are obtained by indirect methods either from vapour pressures (of H_2O or SO_3) by means of Clapeyron's formula or from thermal capacities.—W. R. **Bousfield**: Isopiestic solutions. Solutions of KCl, LiCl, NaCl, and KNO_3 of equal vapour pressure are placed together in an exhausted vessel, so that interchange of aqueous vapour may take place. Hence is indicated an accurate method of determining the vapour pressure of an aqueous solution, by comparison with the equal vapour pressure of a solution of LiCl. The observations lead to the conclusion that for a pure salt without water of crystallisation there is, at a given temperature, a certain vapour pressure of water below which the dry salt surrounded by aqueous vapour will not take up water, and will, if it is not dry, become dried. This pressure may be called the *critical hydration pressure* of the salt at the given temperature.—Dr. J. W. **McBain**: Notes on the system of recording rate of chemical reaction. The usual equation representing rate of reaction may be written in the form $kt =$ (remainder of expression). The author proposes so to choose the unit of time that k is always unity. A single number will then completely record the rate of reaction.—A. L. **Feild**: The viscosity of blast-furnace slag and its relation to iron metallurgy (see p. 373).—G. **Le Bas**: The refractivities of saturated and unsaturated compounds. The refractivities of unsaturated compounds, together with unsaturated systems containing conjugated unsaturated groups, have been considered. Benzene has been shown to be possessed of no anomaly. Cross-linking has been assumed in some cases. The effects of conjugation of ethenoid and carbonyl groups have been shown, whilst nitrates, nitrites, and nitro-compounds have been studied. The oximino-group especially has been taken into consideration. The cyclo-paraffins, substituted and unsubstituted, have been considered, together with a number of *p*-terpenes and derivatives. Anomalies have been connected with the side-chains or substituents and the appropriate numbers ascertained. The larger anomalies are connected with the trimethylene ring. Those for benzene derivatives have been ascertained. The unsubstituted hydrocarbons show no anomalies.—Dr. E. B. **Ludlam**: The effect of hydrogen chloride on the nitrogen-hydrogen equilibrium. The paper records an experimental attempt to simplify the difficult conditions of high temperature at high pressure under which the Haber synthesis takes place. It was thought that the presence of hydrochloric acid during the synthesis would displace the equilibrium in the direction of the formation of ammonia. The result of the experiments was negative.—Dr. H. B. **Maxted**: The influence of carbon monoxide on the velocity of catalytic hydrogenation. The inhibitive effect of small percentages of carbon monoxide on the velocity of hydrogenation of olive oil in presence of nickel has been studied quantitatively.

Geological Society, December 19, 1917.—Dr. Alfred Harker, president, in the chair.—B. **Smith**: The Chellaston gypsum-breccia considered in its relation to the gypsum-anhydrite deposits of Britain. (1) At Chellaston the gypsum was laid down as such, and has suffered no appreciable alteration or addition since the time of its original deposition and brecciation. There is no evidence that the rock was ever anhydrous. (2) By comparison with this deposit, and also by independent evidence, it seems probable that most of the important beds of gypsum in the country were laid down as gypsum, and have behaved throughout as stratified deposits. (3) When anhydrite is present, the evidence favours the view that it is original, and was deposited in a stratiform manner in sequence with gypsum. (4) Microscopic evidence shows that there has been, in some cases, an alteration of anhydrite into gypsum where the two minerals were in original juxtaposition; this alteration, however, is considered to have occurred at, or immediately after, the time of deposition, and to be confined to the existing plane of contact of the two minerals.

PARIS.

Academy of Sciences, December 17, 1917.—M. Ed. Perrier in the chair.—L. **Guignard**: The development of the structure of the ovule in the Apocynaceæ and the Asclepiadaceæ. After a summary of contradictory conclusions arrived at by previous workers on this subject, the author gives the summarised results of his researches on twenty species.—G. A. **Boulenger**: The conformation of the phalangettes in certain African frogs.—M. **Balland**: The alterations in war-bread: an investigation into the cause of war-bread going mouldy. The moisture ought to be from 10 to 12 per cent., but it generally amounts to more, 13 to 15 per cent., and in some of the mouldy bread up to 18 per cent. An alteration in the shape of the loaf is suggested as a provisional measure.—P. **Fatou**: Rational substitutions.—E. **Baticle**: The determination of the most advantageous dimensions of the principal elements of a hydraulic power installation.—M. **Mesnager**: A rigorous demonstration of the formulæ of beams and plates.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the second quarter of 1917. Observations were made on eighty-six days, and the re-

sults are tabulated in three groups showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—M. **Philippon**: The manufacture of silica bricks. A summary of the conclusions resulting from researches made at the Dunes factory during 1916 and 1917. Full details will be given in a later communication. The bricks now being made melt at about 1780° C., and have up to the present supported 200 melts in the Martin furnace.—Ph. **Glangeaud**: The geology of the neighbourhood of Bort (Corrèze).—Ph. **Flajolet**: Disturbances of the magnetic meridian at Lyons (Saint-Genis-Laval) during the second quarter of 1917.—P. **Guérin**: The stamen and the development of the pollen of the sages.—L. **Daniel**: Heredity of the abbreviation of development in the cultivated carrot and beet.—R. **Souèges**: The embryogeny of the Alismaceæ.—J. **Laborde**: The constitution of the fixed acidity of healthy and diseased wines.—E. **Kayser**: Contribution to the study of alcoholic ferments.—L. **Mencière**: Physiological properties and medico-surgical applications of guaiacol and benzoic acid. These two substances, associated with other substances of the aromatic series, have powerful antiseptic properties, and the advantage of not being toxic to the cell. Examples of their application in practice are given.—G. A. **Le Roy**: The photographic analysis of fresh and preserved eggs.

BOOKS RECEIVED.

French Scientific Reader. Edited, with Introduction, Notes, and Vocabulary, by Dr. F. Daniels. Pp. xvi+748. (New York and London: Oxford University Press.) 10*s*. 6*d*. net.

Tommy Smith at the Zoo. By E. Selous. Pp. vii+183+8 illustrations. (London: Methuen and Co., Ltd.) 1*s*. 9*d*. net.

How to Enlighten our Children. By Dr. M. Scharlieb. Pp. 202. (London: Williams and Norgate.) 3*s*. 6*d*. net.

A Course of Pure Geometry, containing a Complete Geometrical Treatment of the Properties of the Conic Sections. By Dr. E. H. Askwith. New edition. Pp. xi+284. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

The Historical Register of the University of Cambridge. Edited by Dr. J. R. Tanner. Pp. xii+1186. (Cambridge: At the University Press.) 12*s*. 6*d*. net.

Cambridge Essays on Education. Edited by Dr. A. C. Benson. Pp. xix+232. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Elements of Constructive Philosophy. By Dr. J. S. Mackenzie. Pp. 487. (London: G. Allen and Unwin, Ltd.) 12*s*. 6*d*. net.

The Principles of Audosis and Clinical Methods for its Study. By A. W. Sellards. Pp. vi+117. (Cambridge, Mass.: Harvard University Press.) 4*s*. net.

The Fishing Village and other Writings. By W. Omer-Cooper. Pp. 184. (Bournemouth: H. G. Commin.)

DIARY OF SOCIETIES.

THURSDAY, JANUARY 10.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Electrical Signalling and Control on Railways: C. M. Jacobs.

MATHEMATICAL ASSOCIATION (London Day Training College), at 11.—The Uses and Functions of a School Mathematical Library: Dr. W. P. Milne.—Nomography: Dr. S. Brodetsky.—Some Suggestions for a Presentment of Mathematics in Closer Touch with Reality: G. Goodwill.—At 2.30.—President's address: Mathematics and Individuality: Prof. T. P. Nunn.—*Discussion*: The Position of Mathematics in the New Scheme of the Board of Education for Secondary Schools; Openers: W. D. Eggar, P. Abbott, Miss J. Dow.

FRIDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY (Kensington Town Hall), at 3.30.—The Old Life in Egypt: Miss Mary Brodrick.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MONDAY, JANUARY 14.

FARADAY SOCIETY, at 5.30.—*Discussion*: The Setting of Cements and Plasters.—The Mechanism of the Setting Process in Plaster and Cement: Dr. C. H. Desch.—Crystalloids *v*. Colloids in the Theory of Cements: Prof. H. Le Chatelier.—The Theory of Setting: Prof. F. G. Donnan.—The Constitution and Hydration of Portland Cement: A. A. Klein.—The Setting and Hardening of Portland Cement: George A. Rankin.—The Setting of Cement in its Relation to Engineering Structures: Bertram Blount.—Note on the Colloidal Theory of Setting: John Rhodin.—The Effect of the Addition of Suitable Slag on the Setting Properties of Portland Cement: E. H. Lewis and E. Deny.—Ancient and Modern Mortar: W. J. Dibdin.

TUESDAY, JANUARY 15.

ROYAL INSTITUTION, at 3.—Palestine and Mesopotamia: Prof. Flinders Petrie.

ILLUMINATING ENGINEERING SOCIETY, at 5.—Ten Years of Illuminating Engineering; its Lessons and Future Prospects: L. Gaster.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Petroleum Industry of Rumania: Capt. T. S. Masterson.

MINERALOGICAL SOCIETY, at 5.30.—Rock Diagrams: Dr. J. W. Evans.—The Use of the Gnomonic Projection in the Calculation of Crystals: Dr. G. F. Herbert Smith.

ROYAL STATISTICAL SOCIETY, at 5.15.—Urban Housing Problems: J. Calvert Shensley.

WEDNESDAY, JANUARY 16.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Annual General Meeting.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address: The Royal Microscopical Society during the Great War—and After: E. Heron-Allen.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

THURSDAY, JANUARY 17.

LINNEAN SOCIETY, at 5.—(1) Restoration of the Head of Osteolepis; (2) Femur of Pterodactyl from the Stonesfield Slate: E. S. Goodrich.—Some Early Cape Botanists: J. Britten.—A Hybrid Stachys: C. E. Salmon.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Incidence of Taxation upon Metalliferous Mining in the British Isles: H. Louis.—Molybdenum in Norway: E. R. Woakes.

FRIDAY, JANUARY 18.

ROYAL INSTITUTION, at 5.30.—Studies on Liquid Films: Sir James Dewar.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Traction on Bad Roads or Land: L. A. Legros.—Utility of Motor Tractors for Tillage Purposes: A. Amos.

SATURDAY, JANUARY 19.

ROYAL INSTITUTION, at 3.—The Chemical Action of Light: Prof. W. J. Pope.

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THURSDAY, JANUARY 17, 1918.

MANUALS FOR THE CHEMICAL LABORATORY.

(1) *Standard Methods of Chemical Analysis.* Edited by Wilfred W. Scott and others. Pp. xxxi+864. (New York: D. Van Nostrand Company; London: Crosby Lockwood and Son, 1917.) Price 30*s.* net.

(2) *The Theory and Use of Indicators: An Account of the Chemical Equilibria of Acids, Alkalies, and Indicators in Aqueous Solution, with Applications.* By Dr. E. B. R. Prideaux. Pp. vii+375. (London: Constable and Co., Ltd., 1917.) Price 12*s.* 6*d.* net.

(3) *Technical Handbook of Oils, Fats, and Waxes.* By P. J. Fryer and F. E. Weston. Vol. i., *Chemical and General.* Pp. viii+279. (Cambridge Technical Series.) (Cambridge: At the University Press, 1917.) Price 9*s.* net.

(1) FOR the analyst whose work embraces a wide range of problems it is comforting to have at hand a book which can be trusted to indicate forthwith the best, or at least the usual, methods of solving such problems. It obviates an undue expenditure of time on the searching of files and indexes, and facilitates the comparing of one process with another, which is usually a necessary preliminary to attacking the task in hand, if that task is a new one.

To a large extent the volume under notice is a work which would be classed as a "laboratory comfort" of the kind indicated. It is a very good selection of "standard methods." The "chemical analysis," however, for which these standard methods are given is largely confined to inorganic substances. True, there is a part devoted to special subjects, which includes sections on the analysis of some organic products, such as oils, fats, waxes, and coals; but in the main the work is concerned with inorganic analysis.

Beginning with "aluminium" and ending with "zirconium," the elements are taken in order, and under each heading are given, first, the chief physical data, namely, the atomic weight, specific gravity, melting point, boiling point, and the oxides formed by the element. Next, the characteristic chemical reactions for identifying the substance are given, and then follows a selection of methods for its quantitative determination. These include gravimetric, volumetric, and electrolytic processes, of which a judicious choice has been made. Any preliminary treatment required by the substance is described under directions for the "preparation and solution" of the sample and its separation from interfering substances.

Many of the newer processes are included, such as the estimation of nickel by means of alpha-benzildioxime and by dimethylglyoxime, and the determination of sulphates with benzidine hydrochloride. A method for the determination of carbon in steel by direct combustion is given, by which, it is claimed, accurate results can be obtained in ten minutes: the improvement lies in supplying a rapid current of oxygen, instead of a slow one as formerly. A welcome feature of the work is the inclusion of the principal "rare" elements amongst those dealt with. In the special part the analysis of alloys, cements, coal, gas, paint, and water, and the assaying of gold and silver are described, as well as the examination of oils, etc., already mentioned.

In general, the treatment of the subject-matter is lucid and concise; "lengthy exposition, theoretical dissertation, and experimental data," the authors say, have been purposely avoided. Only a few press errors have been noticed, but two distinguished names in chemistry have lost their final "e," and appear as "Scheel" (p. 30) and "Thorp" (p. 458). The book will be found very useful as a convenient summary of modern analytical methods within the limits indicated.

(2) Dr. Prideaux's book is mainly one for the advanced student and the investigator. Its purpose is to present a connected survey of the subject of chemical "indicators," *i.e.* the substances used for showing by their changes of colour the occurrence or progress of certain chemical reactions. Much has happened in this region of chemical inquiry since the time when the Romans used red wine as an indicator in testing the "hardness" of drinking water. Even down to a relatively short time ago the number of indicators in general use was but small, *e.g.* litmus, logwood, cochineal, and a few other substances. With the development of synthetic organic chemistry, however, many more indicators have been brought into use—nitro-derivatives, phthalein compounds, aminophenol-methane products, and so on. More important still, the mechanism of the changes whereby the colours of these compounds are produced or altered has been carefully investigated, both chemically, from the point of view of molecular structure, and physically, from that of electrolytic equilibrium in the solution. The author gives an account of the results, and of present views on the subject, including the allied matters of light absorption and theories of colour. Many references are supplied, and workers in this field of research will find the book of considerable utility. For general use its value would be enhanced by the inclusion of an elementary introductory chapter.

(3) Messrs. Fryer and Weston's work is intended to be a conspectus of the chemistry and general scientific principles involved in the manufacture of oils, fats, and waxes. This industry is essentially a chemical one, and a knowledge of the fundamental principles of chemistry, both theoretical and practical, is indispensable for a really intelligent conception of the nature of the processes involved. The authors' experience is that, whilst technical men in the industry generally have a wide knowledge of the practical issues of the subject, this knowledge exists side by side with much ignorance of the basic principles underlying such issues. They, therefore, endeavour to explain, as simply as the theme permits, the theoretical basis on which the technical processes rest. No doubt

it is true, as they remark, that compared with that of many other industries the chemistry of the oils, fats, and waxes is remarkable for its simplicity; but unless the reader has already had some grounding in organic chemistry he will probably conclude, from the pages of formulæ put before him in the earlier part of the work, that it is not such a very simple matter after all.

This apart, the book is a serviceable one for the purpose in view. Practical analytical work is left to be expounded in a companion treatise: the present volume explains the chemical processes and terms used in connection with the fixed oils and their congeners, and gives the physical and chemical data characterising the various products; but it is not intended to be a guide and counsellor for the experimenter. For example, the meaning of "viscosity" is shown, and the values of this constant are given, but detailed directions for actually determining the viscosity are not included; presumably these are reserved for the companion volume.

The interpretation of analytical data, not the way to obtain them, is the key-note of the book. A large amount of information is given in a systematic manner and in a very handy form. The diagrammatic representations of chemical and physical constants are a special feature, which should prove convenient for speedily identifying an unknown oil or fat—in fact, the present writer has already found them useful. C. S.

INCREASE OF AGRICULTURAL OUTPUT.

(1) *British Grasses and their Employment in Agriculture.* By S. F. Armstrong. Pp. vii+199. (Cambridge: At the University Press, 1917.) Price 6s. net.

(2) *Manuring for Higher Crop Production.* By Dr. E. J. Russell. Second edition. Pp. vi+94. (Cambridge: At the University Press, 1917.) Price 3s. 6d. net.

(1) THE task of increasing home-grown food-supplies has steadily forced itself to the front as one of the key-problems upon the solution of which the issue of the war primarily depends. The essential features of the problem are by this time familiar even to the lay public, in so far, at any rate, as they involve the ploughing up of grassland and the planting of corn or potatoes. It is not sufficiently realised, however, even by the farmer himself, that this represents only one part of the contribution which can be effectively made to the desired increase of food production. The total agricultural area of the United Kingdom is roughly forty-seven million acres, of which some twenty-seven million acres are under permanent grass, whilst of the remaining area about six and a half million acres rank temporarily as grassland, being occupied at the moment by rotation grasses and clovers, forming a transition crop in the arable rotation. It is obvious that the utmost efforts in bringing land under the plough can make only relatively small inroads upon this immense acreage of grassland, so that we must continue to depend upon grassland for a very substantial contribution to national food supplies. Moreover, in proportion as the area of arable land increases and that of grassland shrinks, the greater becomes the necessity for devoting attention to the improvement of the latter, in order that adequate grazing for live-stock may be provided by the reduced area.

It requires little acquaintance with farming to realise that a great deal of the existing grassland is of very inferior quality, and it is common knowledge amongst agriculturists that a large proportion of it could be considerably improved. Mr. Armstrong estimates that fully 20 per cent., or not fewer than 5,000,000 acres, of so-called grassland is so infested with weeds and inferior grasses as to represent comparatively worthless herbage. What this means in terms of food production is illustrated by estimates submitted to the British Association in 1915 by Mr. T. H. Middleton, which showed that poor grazing land as it exists to-day produces less than one-fifth of the meat obtainable from the same area of average pasture and little more than one-tenth of the produce of the best grassland.

The improvement of poor grassland must proceed along two broad lines. The first requirement is the establishment of healthy soil conditions by means of drainage, liming, and manuring, and only when these have been secured can the other half of the problem, the establishment of a herbage of the more nutritious grasses and forage plants, be successfully dealt with. A knowledge of the characteristics of the different forage plants and their relation to varying soil conditions is obviously an essential part of the improver's equipment. The subject, for which Mr. Armstrong uses the unattractive name of "Agricultural Agrostology," has received a considerable share of the attention of the agricultural botanist, and Mr. Armstrong has now endeavoured to present it in a form adapted primarily for the agricultural student, but not too technical to be of use to the practical farmer, the seed merchant, and the rural schoolmaster. The major portion of the book is concerned with the botanical characteristics of the various species of grasses, special attention being devoted to those species which are most abundant or of greatest economic importance in the British Isles. The treatment of this part of the subject in the main follows conventional lines, but prominence is given to points that have a special interest for the student of agriculture.

The latter portion of the book deals with the practical problems presented by the grasses in farm economy. The agricultural value of grasses, the valuation of grass-seeds, and the compounding of seed-mixtures receive adequate treatment, whilst a final chapter on the general treatment of grassland gives a brief summary of existing information on a subject which demands much further investigation.

(2) In the improvement of grassland, as in the increase of production on arable land, manuring plays a part of vital importance, and it is in the highest degree desirable that the farmer at this juncture should receive trustworthy guidance in the effective use of manures for all his crops. For

such guidance one looks to Rothamsted, and the rapidity with which a second edition of Dr. Russell's little treatise on manuring has been called for is the best evidence of the success with which he has discharged his obligation. In the briefest compass he gives the clearest possible guidance to the practice of manuring, illustrated throughout by what is probably the most complete summary extant of the results of manurial experiments carried out in this country. The previous edition has been considerably amplified and a very brief chapter added on the breaking up of grassland.

SIR CLEMENTS MARKHAM.

The Life of Sir Clements R. Markham, K.C.B., F.R.S. By Admiral Sir A. H. Markham. Pp. xi+384. (London: John Murray, 1917.) Price 15*s*. net.

IT is not often that the story of a notable life is told by a biographer who is at once sympathetic and impartial. Admiral Sir Albert Markham, the author of the work under review, is not merely closely related to the subject of the memoir, but was his warm and constant friend. Yet he tells his story with the straight simplicity which seems specially to distinguish naval writers, and he leaves his readers to form their own conclusions. Therein lies the greatest charm of the book, for we can well construct for ourselves from the incidents of a life overflowing with energy and achievement the character of a man who enriched the world by many of those "footprints on the sands of time" which serve as indications and guides in the path of generations to come.

The opening chapters of the book are devoted to the career of young Clements whilst he served as cadet and midshipman in the Royal Navy. Incidentally, there is much interesting history of the gradual extension of our geographical knowledge of the Pacific towards the end of last century, and a very clear conception is given of life in a wooden-sided sailing-ship of the latest and smartest class which preceded the introduction of steam, just about the time when steam was beginning to assert a preponderating influence on naval construction. All this is told with the loving interest of a blue-water sailor, and it is easy to gather from the story how the foundations were then laid of that deep admiration and reverence for the Royal Navy which towards the end of Sir Clements Markham's career amounted almost to infatuation. In the sailor boy, too, we can mark the germs of the mature character of the man. Full of generous impulse, which landed him now and then in serious difficulty (as when he rushed headlong, without even the preliminary knock at the door, into the sacred precincts of his captain's cabin to protest against the flogging of a man who had been twice convicted of drunkenness), he finally decided to forsake a career of adventure which he really loved for the prosaic prospects of a life on land, because of a mistaken notion that discipline and fair play could not be reconciled. His persistent adherence to that decision, from which no persuasions of his family and many friends could shake him, was quite characteristic of his subsequent attitude in circumstances which occurred not infrequently when his opinions on more important matters were questioned by those who worked with him in the interests of scientific geography. The word "obstinate" has occasionally been whispered of him; but it is not always easy to say where the line is to be drawn between the firmness which may be essential to the successful issue of an important scheme and the unyielding attitude of the autocrat.

Undoubtedly Sir Clements was able, by reason of his determination and his forceful character, to carry through schemes for exploration in regions of the world where no economic gain could be expected in return for great expenditure, and the whole object of research was purely scientific, which would never have matured in the hands of a more feeble advocate. There are some thrilling accounts of Arctic adventure in the book, which is, perhaps, most interesting in these earlier chapters devoted to the moulding of the Markham character.

The author succeeds in carrying our sympathies with his subject from his earliest years of adventure in the fields of exploration and literature (the young Clements wrote a book on astronomy and physical geography at the age of thirteen!) until the pitiful tragedy of his death occurred, without ever drawing on any idealistic resources of his own. Full justice is done to the noble qualities of the man. His warm-hearted enthusiasm for the supremacy of his country in the wide field of exploration, and his devotion to historical and geographical literature which resulted in the publication of much valuable information which might otherwise have been lost to the world, are easily to be gathered from the pages of this biography. His kindly nature (which won him hosts of friends), his ready assistance to those who wanted it; his life-long interest in all that might benefit humanity, which included the acquisition for England of that life-giving remedy for tropical fevers, cinchona, after a difficult and perhaps dangerous quest for the seeds and plants in Peru—all these things combined to illustrate a character which is perhaps unique in these days, and fully deserves the permanent record which has been so ably rendered by Admiral Sir Albert Markham.

As a rule, biographies written by relatives are accepted with a certain amount of justifiable suspicion. There need be no such suspicion in this case. No one who had the privilege of friendship with the subject of these memoirs will say that there is a word too much of uncalled-for adulation. It is a fair record all through and a most interesting story.

T. H. H.

OUR BOOKSHELF.

Food Poisoning. By Edwin O. Jordan. Pp. viii+115. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1917.) Price 1 dollar or 4*s*. net.

THIS little book gives an excellent summary of the subject of food poisoning. It is not within its scope to consider those cases in which definite poisonous substances are added to food with

criminal intent. The term "food-poisoning" is here limited to the occasional cases of poisoning from organic poisons present in normal animal or plant tissues, the more or less injurious consequences following the consumption of food into which formed mineral or organic poisons have been introduced by accident or with intent to improve appearances or keeping quality, the cases of infection due to the swallowing of bacteria and other parasites which infest or contaminate certain foods, and the poisoning due to deleterious substances produced in food by the growth of bacteria, moulds, and similar organisms. We have no certain statistics of the frequency of food poisoning, but Mr. Jordan has collected data of more than 1000 cases occurring in the United States in the two years October, 1913, to October, 1915.

In the chapter dealing with poisonous plants the poisonous fungi claim most attention. Some reference might have been made to the nutmeg, which is distinctly toxic in large doses, and in smaller doses to some individuals. In the section dealing with food-borne, disease-producing bacteria, the sub-heading is "Paratyphoid Infection," and this term is used many times. What is really meant is Gärtner (*B. enteritidis*) infection, and this organism is distinct from the paratyphoid bacilli, though belonging to the same group. Ptomaine poisoning is too briefly referred to, and we note the omission of all allusion to tyrotoxicon, which is somewhat surprising. One of the best sections is that dealing with food preservatives, to which several pages are devoted. In conclusion, reference is made to such conditions as beri-beri, pellagra, lathyrism, scurvy, etc. The book is well produced, very readable, and illustrated with several figures.

R. T. H.

Adolescence. By Stephen Paget. Pp. 59. (London: Constable and Co., Ltd., 1917.) Price 7*d.* net.

IN the adolescent mind ideas of sex and religious ideas often grow up together, and they should be correlated. While there is a wide range of individual peculiarity within the limits of the normal, there is no virtue in a child's being incurious. Careful preparation should be made by parents and teachers so as to give well-considered and honest answers to embarrassing questions. Perhaps there should be a home-ceremony or an initiation, "the whole thing well thought out, the exhortation written down beforehand, every word of it." "First-rate school teachers are more likely than second-rate parents to say the right thing to children." "The reasonable soul and flesh is one man," and there must be disciplining of both sides. "If I could be a young man again, I would get on without alcohol and cigarettes. . . . Let me, as a doctor, add a good tonic to steady the nerves of adolescence. I prescribe a full dose of the natural sciences." "What does harm the minds of children is not our plain speaking; it is their own secret reading, gossiping, and imagining." "And—so far as adolescence is concerned—if ever there was a time when we ought to speak plainly, it is now."

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Sources of Potash.

SIR EDWARD THORPE'S lucid review of the known geological sources of potash (NATURE, January 3) is of absorbing interest to agriculturists, whose industry must be seriously affected by any permanent stinting in the supply of this indispensable fertiliser, entailing a corresponding diminution in the production of root crops. They might, however, tide over a temporary shortage of potash by availing themselves of a subsidiary source.

The Boards of Agriculture for England and Scotland having recently issued leaflets directing attention to the high percentage of potash contained in bracken fern, Prof. H. G. Greenish, director of the Pharmacy Research Laboratory in Bloomsbury Square, very kindly undertook at my request to make analysis of the ash of incinerated bracken. As it had been stated that the amount of potash contained in the fern cut in autumn showed a considerable diminution compared with that cut at midsummer, I sent Prof. Greenish three consignments, cut respectively in July, September, and, after the plant had withered, in November. The result proved practically the same in each case, and I may quote as follows from Prof. Greenish's very full report:—

"I find that the fern, when dried in a warm room and *completely* burnt to a nearly white ash, yields 4·82 per cent. of ash. This ash contains 41·5 per cent. of potash, K_2O. The dried fern itself would therefore yield 2 per cent. of potash, or 50 tons of fern would yield about 2·41 tons of ash, in which there would be about one ton of potash. . . . In addition to the potash the ash contains small quantities of soda, phosphates, sulphates, and chlorides."

It is clear from this that, although bracken can never compete with geological deposits as a source of potash, a considerable amount might be recovered by harvesting and burning the fern under a proper system. At the same time, it would tend to rid the land of a pest which has destroyed much of the best hill pasture in the North, and is spreading year by year. Bracken will grow only on good land; it cannot thrive on marsh. The destruction of pasture is far from being the only evil; animals feeding among bracken get their heads and necks covered with ticks—in fact, the death of a considerable number of sheep in this county seems to be justly attributed to this cause alone. If, therefore, land can be cleared of a most pernicious weed, and, at the same time, a valuable manure obtained for tillage, there are many farms where the work might be profitably undertaken.

The analogy of kelp presents itself. I understand that it takes from twenty to twenty-two tons of good wet seaweed to produce a ton of kelp, which yields between 30 and 40 per cent. of potassium salts, more than double the return from an equal weight of dried fern, besides the iodine which is recovered from kelp. But, on the other hand, it is far easier to cut bracken than to gather deep-sea tangle, and the ash can be used as a fertiliser on the farm where it is burnt.

Driving lately from Dorchester to Abbotsbury, I saw hundreds of acres of downland rendered absolutely valueless by bracken, whereof the luxuriant growth betokened a soil well adapted either for tillage or forestry.

HERBERT MAXWELL.

Monreith, Whauphill, Wigtownshire, N.B.

The Supposed "Fascination" of Birds by Snakes.

I HAVE been making further inquiries from my naturalist friends, and find Capt. G. D. H. Carpenter's observation recorded in NATURE of November 29 last (p. 244) is confirmed, together with the interpretation there suggested.

Dr. G. A. K. Marshall writes:—"The mobbing of snakes by small birds, and even by fowls, was frequently mentioned to me by residents in South Africa, and my general impression is that I have observed it on various occasions without specially noting it, and I cannot now recall the details of any particular case."

Mr. S. A. Neave, with a wide African experience, felt that the facts recorded by Capt. Carpenter were familiar to him, and associated in his mind "with parties of small finches and weaver birds in open, grassy places," but he was unable to remember any particular instance.

Mr. J. C. Kershaw, for a long time resident in Macao, China, and a traveller in the Malay Archipelago, Australia, and the West Indies, writes:—"I have often seen snakes pursued and annoyed by birds, just as cuckoos and hawks are by small birds, but never saw any sign of 'fascination' by the snake to obtain prey."

Mr. Kershaw has observed the mobbing of all kinds of snakes, and in many countries. "In China *Lanius schach* and *Dryonastes perspicillatus* especially raised an outcry over snakes. I remember one day hearing some shrikes (*L. schach*) making a great hubbub in a tall, thick bush; investigating, I found a snake (some 6 ft. or 8 ft. in length) in the upper part, and threw a clod of turf at it, striking it (by a fluke) about the middle of the body. The shrikes flew off, but the snake remained motionless for nearly half a minute, and then suddenly darted off. The light clod could not have really hurt it."

Mr. J. Williams Hockin, with a very long experience of South India, writes:—"The only case of birds *v.* snake I can remember is seeing a cobra attacking the nest of a ground thrush in a coffee tree at 3 ft. from the ground, and being clamorously assailed by the parents." A little later my friend kindly supplied further details of his observation:—"The cobra attack on ground thrushes (Geocichla, the slate and buff, not Pitta, the ruddy and kingfisher blue one) occurred in the Ellembelary Coffee Estate, three miles from Mepādi Village, in Malabar Wynaad, at an elevation of 3500 ft. So far as I can remember, it was eggs and not young birds the snake was after, but I cannot be sure. It was between 1894 and 1899. As you suppose, I was more humanitarian than scientific in those days, and got off my horse and went into the coffee to drive the snake off. The nest was on the top of a tree about 3 ft. high, the top forming, with those around it, a flat sheet of coffee. The snake was round the stem with its head over the edge of the nest, and the parent birds on each side, shrieking for all they were worth and fluttering round about on top of the boughs. On my approach the snake glided away, and the coffee was too thick for me to get at it. I do not think it took anything. The coffee in Wynaad was topped at 3 ft. or so, and all suckers removed when they appeared, so as to keep an even sheet of cover on the ground."

Not one of the above-named naturalists had seen anything like the traditional "fascination" of birds by snakes. Mr. F. Muir, however, told me that he had seen a bird—I believe in East Africa—sitting on a branch with its bill open and unable to move, while a snake approached and swallowed it. This *may* be an instance of "fascination." Weak-minded birds may sometimes act in this suicidal manner, just as some human beings may be paralysed by fear and unable to defend themselves or to escape from danger. But another interpretation is suggested by the following extremely interesting observation recorded by Dr. G. A. K. Marshall:—"When happening to look over a low stone wall near Estcourt, Natal, in 1897, I chanced to observe a small snake in the very act of striking a frog. After being bitten the latter hopped off at a great pace, and I was rather surprised to see that the snake made no attempt at pursuit, but merely followed in a very leisurely manner. Seeing that the frog had come to a standstill at a considerable distance off, I crept along under the wall, so as not to disturb the snake, and on getting near the frog I looked cautiously over the wall to see the end of the tragedy. The snake was still some way behind, approaching steadily, and on reaching its victim stood watching it for some moments with its head raised, the frog meanwhile sitting trembling in front of it. At last the snake seized its prey, and succeeded in swallowing it after but feeble resistance. It seemed clear that the trembling and inability to escape on the part of the frog were simply due to the action of the poison injected at the snake's first bite. It immediately occurred to me that these observations might supply a simple explanation of many of the stories of 'fascination' by snakes."

EDWARD B. POULTON.

Oxford, January 2.

THE SCIENTIFIC BASIS OF RATIONING.

AN ideal ration is one which provides the adult with sufficient potential energy to meet all the demands made by the organs of his body for transformation into the kinetic form, and enough building material to make good the wear-and-tear of essential cells; a complete ration for children and adolescents must also make provision for the requirements of growth. Three methods of determining the quantities needed to fulfil these conditions are available. The first is to follow as closely as possible the system of an engineer, viz. to study the efficiency of the human machine as a transformer of energy when measurable amounts of work are performed under determinate conditions. The second is to measure the total energy transformed by the body under various conditions, also determinate, although not necessarily permitting of an exact evaluation of the amount of mechanical work done. Lastly, when it is neither possible to measure directly the energy transformed nor to evaluate the work done, the composition of diets consumed by samples of men engaged in different occupations throws light upon the probable needs of different classes.

These methods have been enumerated in a descending order of importance so far as the accuracy of the information which, under favourable conditions, they might yield is concerned; so far as practicability is involved, under normal conditions of life, the order is reversed. We shall refer briefly to the data available under each heading.

(1) The only type of work respecting which numerous and exact measurements both of energy transformed and of external work done are available has been that carried out with a stationary bicycle, the wheels of which are rotated against a known resistance. The best series of experiments is due to Benedict and Cathcart,[1] whose

[1] "Muscular Work: a Metabolic Study." (Washington, 1913.)

results are concordant with those of Macdonald[2] and others. From these experiments it appears that, for any one person, the relation between H, the total energy transformed (measured in thermal units), and W, the external work done (also measured in thermal units), is adequately expressed by the equation $H = aW + b$, where a is a constant and b a variable parameter, varying with the speed of work performance. In the case of a professional cyclist, upon whom Benedict and Cathcart performed a large number of experiments, a was approximately equal to 3·3, while b increased from 2·4 to 5·2 as the rate at which the pedals were rotated increased from 68–72 to 108–112 revs. per min. When unpractised persons used the ergometer the value of a increased, but the available data were not sufficient to permit of the parameters being determined with any accuracy.

From these results we may infer that (i) the incremental efficiency of muscular work may be as high as 30 per cent. in favourable circumstances, and (ii) the total cost of work performance depends upon its rate. We can scarcely, however, venture to generalise the arithmetical results by using them to calculate the needs of those doing other kinds of work.

(2) This method was largely used by Zuntz and Schumburg[3] in their well-known study of the requirements of marching soldiers, and has also been employed by Amar[4] in investigating the energy transformations of industrial workers. Many physiologists, including Atwater and Benedict, Voit, Rubner, and Tigerstedt, have carefully determined the heat output of persons at rest, obtaining reasonably concordant results, so that the energy transformations of workers can be contrasted with those of sedentary persons.

From Amar's experiments it appears that a metal filer plying his tool at the rate of 70 strokes per minute (a skilled operative, aged thirty-eight years, weighing 74 kilograms) would transform or liberate 3656 Calories daily if he worked at the rate mentioned for eight hours, slept for eight hours, and "rested" the remaining eight hours. The figure just given is reached on the assumption that the heat output during sleep is 1 Calorie per kilogram of body-weight an hour; during non-working but waking hours, 1·25 Calories—assumptions in accord with the means of other experiments. Allowing a margin of 12 per cent. to cover unavoidable waste in the preparation of food and non-assimilation of portions of the ingredients consumed, this daily transformation is covered by a diet having an energy value of 4155 Calories as purchased. Little significance attaches to an isolated series of observations, and it is to be hoped that the method will be more widely employed in that organised physiological research into industrial conditions which is an urgent need of the time.

(3) This process has been widely adopted, the largest individual collections of statistics being (a) those recently compiled and analysed by the Welfare and Health Section of the Ministry of Munitions, and relating to more than 18,000 munition workers[5]; (b) the studies issued from the Nutrition Laboratory of the United States Department of Agriculture, which cover more than 13,000 persons, of whom, however, only a small minority were industrial workers[6]; (c) the Solvay Institute's analysis of the food consumption in more than 1000 Belgian industrial families[7]; (d) English urban working-class and agricultural budgets analysed by the Board of Trade some years ago.[8]

In the following table mean values computed from the above-mentioned material (omitting the American data, which may not be strictly comparable with those describing European conditions) are collected :—

Source of data	No. of observations	Grams of protein daily	Grams of fat daily	Grams of carbohydrate daily	Calories daily
English agricultural families	More than 100	90·9	92·4	570·3	3571
Urban industrial families, earnings 25s.–30s.	289	91·8	70·6	564·6	3348
Urban industrial families, earnings 30s.–35s.	416	99·0	82·4	587·6	3581
Belgian industrials, moderate and hard work	687	(83·4)	(98·3)	(524·3)	(3495) 3972
Belgian industrials, very hard work	372	(84·3)	(113·1)	(562·8)	(3772) 4286
English munition workers (1917)	18,000	115·7	141·3	408·4	3463

The average for the whole 1944 families (wages ranging from less than 25s. to more than 40s.) is :—

Protein	Carbohydrate	Fat	Calories
98·8	593·2	83·7	3615

The figures in this table, excepting those for Belgium, refer to food as purchased. The Belgian investigators have expressed their results in terms of food absorbed by the digestive organs; the deduced averages are accordingly enclosed in brackets, not being directly comparable with the others. The unbracketed figure for Calories is that obtained on the assumption that a discount of 12 per cent. should be allowed between purchased and assimilated values, and is (if the assumption be admitted) comparable with the remaining average energy values.

These statistics must be interpreted with caution. Two assumptions are made in computing nearly all averages of the kind, and a third is often involved also. The assumptions in question are (a) that published analytical results showing the composition of foodstuffs are generally applicable to the qualities used by the persons whose

2 Proc. Roy. Soc., B, 1917, vol. lxxxix., p. 394.
3 "Studien zu einer Physiologie des Marsches." (Berlin, 1901.)
4 "Le moteur humain" (Paris, 1914), pp. 527 *et seq.*

5 Summarised in Dr. Leonard Hill's "Memorandum on Workers' Food" (Health of Munition Workers Committee, No. 19, Cd. 8798).
6 Contained in successive Bulletins of the U.S.A. Department of Agriculture.
7 Slosse and Waxweiler, "Enquête sur le Régime alimentaire de 1065 ouvriers belges." (Brussels, 1910.)
8 Board of Trade, 1903, Cd. 1761, p. 210; 1913, Cd. 6955, p. 300.

diets are under investigation; (*b*) that in families composed of persons of different sexes and ages the individual distribution of food among the members of the families can be expressed by the age and sex coefficients proposed by Atwater; (*c*) that published coefficients of wastage and proportional absorption are trustworthy. In addition to these special difficulties there are, of course, the usual pitfalls of statistics (errors of sampling, randomness or otherwise of sampiing, etc.).

From the evidence furnished by a short series of control experiments carried out by the Belgian inquirers, Slosse and Waxweiler, it seems likely that the American coefficient of reduction for sex, *i.e.* putting the consumption of an adult woman as 80 per cent. of that of an adult man, is not far from the truth; but, on the other hand, the American coefficients of consumption by children may be appreciably too small. The result is that, so far as reduction to "man values" is concerned, the English munition workers' mean is accurate, while the means of the other collections of data (which are reduced from family budgets comprising the nourishment of children as well as that of adults) may over-estimate the *per caput* "man" consumption, perhaps even as much as 20 per cent. Regarding the discount to be allowed for waste in preparation and non-assimilation, much depends upon the constituents of the diet, and the figure of 12 per cent. cannot be regarded as more than a very rough approximation.

Notwithstanding these limitations, the value of the data is considerable, and a study of them might induce some popular journalists and amateur food economists to moderate their strictures upon the extravagance of the English working classes which is alleged to have been fostered by the wartime rise in wages. The data do not suggest that the energy value of the diet consumed by so important a group of operatives as the munition workers is substantially greater than that received by persons of the same social and industrial class before the outbreak of hostilities. The distribution of energy between the three classes of foodstuffs has been different, an inevitable result of the potato famine and the appeals to eat less bread which characterised the period (spring and summer of 1917) during which the data were collected.

The general conclusion to be drawn from the statistics and the relatively few experiments available is that 3500–3800 Calories in food as purchased are by no means an over-estimate of the nutritive requirements of an adult man engaged in moderately strenuous work. Recent work, indeed, confirms the view that Atwater's standard, so far as energy value is involved (3500 Calories), is not an extravagant one.

The *British Medical Journal* in its issue of December 1 directed attention to the fact that the Food Controller's voluntary ration for men on medium work provided about 2100 Calories, leaving a deficit of 1400 Calories from the total of 3500, which the evidence just set out shows to be a minimum requirement of workers in this class. Our contemporary concluded that a weekly consumption of 9½ oz. of fish and a daily consumption of one pint of milk were as much as could be hoped for from these so far unrationed articles, which leaves (cheese being notoriously scarce) a balance of nearly 950 Calories to be obtained from potatoes, involving a daily consumption of more than two pounds. These facts show the urgent necessity of carefully organising the distribution of potatoes within the country and the obligation imposed upon persons living near the centres of supply (for instance, in suburbs with available allotments) to make free use of potatoes, thus helping to increase the quantities of cereals available in the industrial districts to which bulky vegetables are not easily transported. The gravity of the situation imposes a further duty upon the readers of a scientific journal, who must inculcate upon their friends the elementary principles of bioenergetics. That the relation between muscular work and food is as close as that between the mileage of an automobile and its consumption of petrol is a truth still hidden from nine out of ten educated persons; ignorance of the facts has been the parent of many untrue charges.

M. G.

SCIENTIFIC WORK OF THE MEDICAL RESEARCH COMMITTEE.

THE third annual report of the Medical Research Committee, which has recently been published (Cd. 8825: H.M. Stationery Office, price 6*d.* net.), testifies to a very large amount of work of a varied nature. A notable proportion of this has necessarily been devoted to problems arising, directly or indirectly, from the war. But the introductory remarks rightly point out that it is meaningless to try to separate the practical from the scientific aspects of any set of investigations. There are many problems, moreover, which the state of war brings into urgency for solution and, at the same time, offers unique opportunities for inquiry.

Limits of space forbid the reference in detail to all the questions dealt with in this very interesting and important report, and a mere list would be of little value or interest in itself. The report should be read carefully by all who have at heart the health and efficiency, not only of our sailors and soldiers, but also of the nation as a whole. It is proposed here rather to direct attention to a few results of general scientific importance.

It cannot escape notice how prominent have become the methods and results of the physiological laboratory. Two cases may be mentioned in illustration: the regulation of industrial work in relation to fatigue, and the supply of oxygen to men flying at high altitudes. In other instances our ignorance of fundamental physiological processes has been vividly brought home to us. One of these may be referred to in the next place.

Many diseases are caused, as is well known, by the invasion and presence in the blood of minute organisms of animal or plant nature, protozoa or bacteria. This is now, indeed, a matter of common knowledge. For a long time efforts have been

made to discover some chemical agent which shall be able to kill these organisms, without injury to the tissues in which they flourish; but with little success. It is somewhat remarkable that most success has been obtained, not, as might have been expected, with the destruction of plant organisms, but with certain protozoa which have shown themselves to be readily susceptible to the toxic action of metals in organic combination. The present report gives an account of some steps towards the solution of the general problem. The hypochlorites introduced by Dakin have been found, in the hands of Lorrain Smith and Ritchie, to be comparatively non-toxic when injected into the veins in the form of "Eusol," while having an unmistakably beneficial effect in certain infections. But, as Dakin has shown, hypochlorites enter at once into combination with the proteins of the blood and cannot be supposed to exert a direct bactericidal action therein. The effect is apparently produced by some change in the blood itself, and it is interesting to note that Dale and Dobell have been led to the conclusion that the action of alkaloids on the amœba of dysentery outside the body is not an index to their therapeutic efficiency, and that their influence on the tissues of the patient is of equal importance. On the other hand, the work of Dr. Carl Browning and his colleagues has brought forward a compound, related to the acidine series of dyes, which is apparently much more toxic to bacteria than it is to animal cells. On account of its colour, this antiseptic was originally called "flavine." It kills bacteria in concentrations in which it has but little effect on the activity of leucocytes, and is non-toxic in intravenous injection. Since the report was issued Dr. Browning has described experiments in which rabbits received intravenous injections of flavine without harm, but the serum of which was found *in vitro* to destroy bacteria. Opinions are, as yet, divided as to the value of flavine as a treatment for wounds. Some surgeons find that it prevents the normal growth of new tissue; but it is possible that the correct conditions have not yet been discovered.

In connection with the practical use of these various antiseptics, the law of distribution between phases, according to solubility, receives application in the value of the solutions of dichloroamine, acriflavine, and iodoform in fatty solvents, such as eucalyptol, paraffin, and soap.

The physiological importance of the presence in the organism of minute quantities of certain chemical substances, the constitution of which is, for the most part, unknown, becomes every day more evident. In two respects the report adds further valuable information. The "accessory factors" in food, without which growth is impossible and various diseases develop, appear to be of some variety and number. The growth factor in milk is shown by Winfield, in the laboratory of Hopkins, to be preserved in the drying process, a fact of practical bearing at the present time. The necessity of such factors for the growth of unicellular organisms themselves has been known for some time, but Miss Jordan Lloyd adds an important further contribution in her investigation of culture media for bacteria. She is of opinion that these growth factors act as catalysts. The chemical reactions, or some of them, necessary for growth proceed naturally at too slow a rate to be effective; but they can be accelerated by the presence of the factors in question. This hypothesis is in agreement with the fact that, although the substances are present in very small amount, they do not disappear from the organism for some days after the food has been deprived of them. They appear to exercise their function without themselves suffering chemical change. The second important addition to our knowledge concerns the internal secretion of the parathyroid glands. Noel Paton and his coadjutors show that the muscular tremors, which make their appearance when these glands are removed, are due to a disturbance of the metabolism of guanidine, which becomes present in excess under these conditions.

A brief reference should be made to the results of the laborious statistical work undertaken by the Committee, especially to that which shows the occurrence of two distinct types of micro-organisms producing phthisis. The comparative incidence of kidney disease in the ordinary population and in the men in the trenches also deserves mention. The value of the statistical method, under appropriate control, is well demonstrated.

A final reference may be made to the latest development of the Committee's work (see p. 78 of the report). The present writer, when visiting some casualty clearing stations in France and Flanders in August last, found so great a divergence of views as to the cause and treatment of the "shock" following injury that, on his return, a special investigation committee was formed, consisting of surgeons at the front and laboratory workers in England. Results of much physiological importance may be expected, especially as to the cause of the low blood-pressure and its indirect effects. Several memoranda are already in course of publication.

W. M. BAYLISS.

SCIENCE AND INDUSTRY IN AUSTRALIA.

THE Executive Committee of the Advisory Council of Science and Industry for the Commonwealth of Australia has recently published a report covering the period from its appointment to June 30, 1917.[1] The Advisory Council was originally appointed on March 16, 1916, and was intended to be a temporary body designed to prepare the way for a permanent Institute of Science and Industry, and to exercise in a preliminary way the functions that will in future belong to the institute.

The council as a whole has met only twice, but a vast amount of work has been done through committees. The Executive Committee has previously made two reports, but the document recently issued is a survey of the work done, and represents to a large extent the completion of the task of the temporary organisation in preparing the way for the permanent institute.

[1] C. 7963. (Melbourne: Government Printer.)

The activities of the committee have been far-reaching. Attention has been given to the encouragement of researches already in progress, and it has initiated many fresh inquiries. It has got into touch with colleges and technical institutes, and collected information as to the facilities for research and the supply of research workers. But the main work of the committee has consisted in a most exhaustive survey of the problems retarding the development of existing industries, and of the research work necessary for the establishment of new industries. It would be almost tedious to enumerate the subjects which have received attention; no industry has been neglected, but perhaps special attention has been devoted to the agricultural and pastoral industries.

Some very sound principles are again and again emphasised in the course of the report. The necessity of securing a greater supply of skilled research workers is frequently referred to, and the committee has made a beginning in the way of encouraging promising students to take up such work by finding remunerative employment for some of the men at present available.

A second point which is regarded as of great importance is the improved training of artisans in technical schools. If research methods are to be more generally applied to industries, it is clear that greater skill and accuracy will be required from the general body of workers, so that it is not merely the duty of the universities and colleges to supply highly trained research workers, but the technical schools have also the important duty of educating the artisan for the new type of work required under the new conditions.

We detect here and there in the report a tendency on the part of the committee not to wait for an industry to come to them, and, indeed, not even to delay in order to secure the co-operation of the industry, but to get research work going when convinced of the necessity for it. For example, the Executive Committee decided to appoint a special committee to investigate the processes of extraction of tannin from wattle bark, and feeling that negotiations with the tanners in all the States would take too long, the investigations have been commenced without waiting for financial assistance from the industry. This method of procedure is interesting, and one would like to get further information as to whether the committee intends to publish freely the results of such investigations, or whether it is going to communicate them to firms on certain conditions.

The present report is in the main confined to a survey of the promising fields for research work, and does not deal with questions connected with the administration of public funds. Most people will probably regard it as of good omen for the success of the scheme in Australia that research, and not administration, is being given the premier place, although no doubt the authorities of the institute will find it very necessary to formulate some guiding principles. In the attempt to apply science to industry it is, however, quite clear that the result will be fatal if we take too great care to avoid a few mistakes and thus set up a system with a tendency to damp the enthusiast.

There is one respect in which the present report is rather peculiar. As we have stated, it is in the main a survey of the field for future work, but in describing the proceedings of several of the sub-committees there is included an account of the experimental results obtained in some of the researches that have been started. The effect produced is scarcely satisfactory, as the researches are only in their initial stages, and it is not possible to give definite conclusions. The public should not be encouraged to expect results of importance to industry too soon, and when given they should be stated as definitely as possible.

The Executive Committee has evidently carried out its duties with great thoroughness, and has made a very complete survey of Australian industries. In matters relating to agriculture and stock breeding the work of the Australian Institute promises to be of special interest to the mother country if we are really determined to apply science to agriculture in a systematic way in the future.

NOTES.

WE are very glad that the Government has been induced to abandon the intention to use the British Museum at Bloomsbury for the purposes of the Air Board and the Natural History Museum at South Kensington for other Government departments. Lord Sudeley directed attention to the proposed appropriation of these buildings in a question asked in the House of Lords on January 9, and, in reply, Earl Curzon said that, as regards the British Museum, he was glad to state that for the accommodation of the Air Ministry it was no longer necessary to appropriate that building. As to the Natural History Museum, it had been found, after detailed examination, that any attempt to convert the galleries into public offices would involve the closing of the building to the public, extensive internal rearrangements, and the consumption of an enormous amount of labour and material and very considerable delay. In these circumstances it had been decided that there was no necessity sufficiently urgent to warrant the use of the museum as had been contemplated.—This decision has given much satisfaction to all who cherish regard for national prestige and understand the intellectual stimulus or practical value of the collections in our national museums. What astonishes us, however, is that Sir Alfred Mond, the First Commissioner of Works, and a son of the late Dr. Ludwig Mond, should have placed himself in such an indefensible position by putting the scheme before the Government. It is difficult to comprehend also why, before deciding to requisition the building, the Government did not inquire as to whether such action was imperatively needed, and consult the trustees and other responsible authorities as to what its consequences would be. If that had been done, a storm of protest would have been saved, and Earl Curzon would not have had to confess in the House of Lords that there was no real necessity for the proposed occupation, which would, indeed, have been more like the act of an invader than of a Government entrusted with the care of national interests in every direction. The trustees of the museum, at their meeting on January 12, ex-

pressed their gratitude, on behalf of the nation whose treasures they hold in trust, to the newspapers which so unanimously gave voice to the public disapproval of a proposal which threatened the safety of the museum and its collections.

REPORTS and opinions relating to the "capture" of 257 recipes for manufacturing dyes produced by the Badische Company appeared in the *Daily Mail* of January 10 and following days, and the subject has been much commented on by other journals. It has been rightly pointed out that the view that the knowledge thus gained will enable us after the war to compete with Germany in every line of dyed goods is too sanguine, and that, although the possession of these recipes may undoubtedly be of considerable assistance, it is a comparatively small item in the general scheme that it is necessary should be organised for the satisfactory establishment of the dye industry in this country. The provision of buildings, plant, and labour is not easy under war conditions, and, of course, more chemists and engineers are required. Were all these readily available, however, it is doubtful whether the inexpert organisations controlling most of the undertakings in England could hope to establish one of the most scientific of industries. In the extensive literature on this subject that has appeared during the last three years the necessity for chemists, engineers, and plant has been repeatedly urged, but the outstanding feature of the great German organisations, namely, that the boards of directors can, and do, direct their businesses, seems to have been overlooked. If, as is suggested, the Government can be induced to acquire these 257 recipes for the benefit of the nation an admirable opportunity will arise of organising the industry as a whole. More than twenty firms are now advertising the sale of dyes manufactured by themselves, but it is evident that each has started independently, with the result that the majority are making "sulphide" dyes. Unless some mutual arrangement can be made according to which the whole field of manufacture is divided out in order to prevent undue overlapping and to provide a wide range of products, many of these praiseworthy beginnings will inevitably come to an early end.

THE following official announcement was made on Monday:—It is with great regret that the Secretary of State for War has decided that the time has come when Surgeon-General Sir Alfred Keogh, G.C.B., Director-General of Army Medical Services, must be permitted to resume his duties as General Executive Officer to the Imperial College of Science and Technology, and he will be replaced at the War Office from March 1 next by Col. T. H. J. C. Goodwin, Royal Army Medical Corps, until recently the Assistant Director of Medical Services to the British Recruiting Mission in America, who will be appointed Acting Director-General of Army Medical Services. Sir Alfred Keogh's services were placed by the governors of the Imperial College of Science and Technology at the disposal of the War Office at the beginning of the war, and, although during the last three years they have on several occasions requested that he should return to his former duties owing to the development of matters of great national urgency which are delayed by his absence, it has not hitherto been possible to spare him. It is very largely due to Sir A. Keogh's intimate knowledge and grasp of all matters connected with the Army Medical Services and the medical profession generally that the medical needs of the Army have been met to the fullest extent during the war, and he has been able to secure the assistance and advice of various committees of eminent consultants, which it is hoped will continue to be at the disposal of his successor.—We understand that Sir Alfred Keogh has for some time desired to return to his work at the Imperial College. The Royal Army Medical Corps as it now exists is essentially his creation, and his organisation of it to the present state of efficiency and strength is a high testimony to his great administrative powers and an achievement of which the nation is justly proud.

THE National Museum of Wales has received an important addition to its collections through the gift by Lord Rhondda of the "Rippon" collection of insects, shells, and minerals. The late Mr. Robert H. F. Rippon was an enthusiastic and careful collector, and is well known to entomologists as the author and illustrator of "Icones Ornithopterorum." By dint of assiduous labour during more than forty years he accumulated very extensive collections, which are especially rich in Lepidoptera; there are more than 3000 specimens of Papilionidæ and more than 5000 of Nymphalidæ, the whole insect collection consisting of above 100,000 specimens. In addition to the more showy forms, such as the cones, cowries, olives, volutes, and the like, the shells include a long series of land shells from the tropics and the islands of the Pacific Ocean. As these collections are mainly exotic, they will supplement, and not duplicate, those already in the museum, which are for the most part British. It remains to be added that the specimens are in excellent condition, and the localities have in almost all cases been recorded. Another welcome gift recently received by the museum has been the British Hemiptera, Neuroptera, and allied groups from the "Briggs" collection, which were presented by Mr. Ernest Heath.

WHAT has been done to make use of waste stores in the Army is described in a reply given by Mr. Bonar Law to a question asked by Mr. Herbert Samuel, chairman of the Select Committee on National Expenditure. A Salvage Board has been formed, with the Quartermaster-General as chairman, to deal with the use and disposal of all waste stores. The following are amongst the results achieved:—(1) From waste fats collected from Army camps alone have been produced: (i) Tallow sufficient to provide soap for the entire needs of the Army, Navy, and Government Departments, with a surplus for public use, producing an actual revenue of about 960,000*l*. per annum, in addition to saving valuable tonnage; (ii) 1800 tons of glycerine for ammunition—sufficient to provide the propellant for 18,000,000 18-pr. shells. The glycerine costs the Government 59*l*. 10*s*. per ton as compared with 300*l*. per ton, the price of imported glycerine. (2) Well above 1,000,000*l*. worth of military rags have been recovered and used in the manufacture of new cloth and blankets for the Army. (3) Many thousands of pounds' worth of cuttings from cotton textiles have also been recovered and utilised in connection with munition and aeroplane requirements. (4) Some hundreds of thousands of pounds' worth of condemned boots have, after the expenditure of some labour in sorting and minor repairs at very small cost, been sold for distribution among the labouring classes, agricultural and industrial

AMONG the changes recently announced as having been made at the Admiralty one has reference to the organisation of the Admiralty Board of Invention and Research. The object of the change is to secure greater concentration of effort in connection with scientific research, and to ensure that the men of science who are giving their assistance to the Admiralty are

more constantly in touch with the problems upon which they are advising. Mr. C. H. Merz, the electrical consulting engineer, who has been associated with the Board of Invention and Research since its inception, has consented to serve as Director of Experiments and Research (unpaid) at the Admiralty to direct and supervise all the executive arrangements in connection with the organisation of scientific research. Mr. Merz will also be a member of the Central Committee of the Board of Invention and Research under the presidency of Admiral of the Fleet Lord Fisher. The functions of the Central Committee will, we learn from the *Times*, as hitherto, be to initiate, investigate, develop, and advise generally upon proposals in respect to the application of science and engineering to naval warfare; but the scientific experts at present giving their services will in future work much more closely with the technical departments of the Admiralty immediately concerned with the production and use of apparatus required for specific purposes. The general arrangements in regard to the organisation of scientific research will in future come under the direct supervision of the First Lord of the Admiralty.

THE *Times* of January 8 contained a letter from Profs. J. Stanley Gardiner and G. H. F. Nuttall on the applicability of the method of preserving herrings by freezing in brine, and on January 10 Mr. J. M. Tabor had a letter dealing with the process from the commercial point of view; a further letter in the *Times* of January 14 appeared from Profs. Gardiner and Nuttall. The method suggested by the last-named is evidently the Otteson method developed and worked in Norway, Sweden, and Holland. It was investigated by Mr. H. Bull, of the Norwegian Fisheries Bureau, and later by a commission of three experts appointed by the German Government. There is a very good account of the process and its effect on the tissues of fish in the *Fish Trades Gazette* of October 20 last. The fish are frozen rapidly in solutions of salt in water of such strengths that the temperature can be reduced to 6·8° F. if necessary. "Glazing" by the formation of an ice film occurs and prevents osmotic interchange, and the rapidity of the freezing produces very small ice-crystals between the muscle-fibres, instead of the large crystals which are mainly responsible for the deterioration of the flesh. Experiments on a commercial scale were made at Fleetwood and elsewhere in this country in 1917, and successful results were obtained, so much so that it was claimed by the writer of the article in the *Fish Trades Gazette* that the very difficult problem of refrigeration of sea fishes had been completely solved, and strong recommendations were made for its commercial adoption. It is suitable for most species of fish, but herrings and some others require rather careful handling, and gutting is probably necessary. Mr. Tabor's letter in the *Times* directs attention to the practical side of the matter, suggesting difficulties that are, just now, very formidable. A further, very useful contribution to this important discussion is contained in the leading article of the *Fish Trades Gazette* of January 12.

ACCORDING to a note in *L'Economista d'Italia* for January 1, an eminent Brazilian geologist has been commissioned by his Government to investigate the deposits of oxide of zirconium in the Caldas region (Minas Geraes), as well as to carry out further work to ascertain the extent of the coal formations in the State of São Paulo.

THE presentation of the Thomson Foundation gold medal of the Royal Geographical Society of Queensland was made to Dr. Griffith Taylor on November 8 last for his thesis on "The Settlement of Tropical Australia," which deals specially with the control of crops and health in relation to temperature and rainfall. The progress made in the settlement of this part of Australia is also compared with that of other tropical areas.

MR. R. BULLEN NEWTON, F.G.S., of the Geological Department, British Museum, has just completed fifty years of Government service. Shortly after entering on his official career, which commenced on January 6, 1868, Mr. Newton became one of the assistant naturalists of the Geological Survey under Prof. Huxley. He was transferred to the British Museum in August, 1880. His numerous published researches on various branches of palæontology, especially the Mollusca and Foraminifera, have had a direct bearing on the geology, both theoretical and economic, of widely scattered regions. Mr. Newton has been president of the Malacological Society of London and of the Conchological Society of Great Britain and Ireland.

THE buildings of Dalhousie University suffered severely in the recent explosion on the munitions ship which wrecked the northern part of the city of Halifax, N.S., on December 6 last. Nearly all the windows in the medical school were blown in, and much material in the laboratories was destroyed. The new science buildings and library suffered almost worse damage. On the day following the disaster there was a blizzard, during which much snow was driven into the buildings before the windows could be boarded up. The damage is being rapidly repaired, and arrangements are being made to continue the session this month. No members of the staff were injured. Prof. Fraser Harris has been asked by the military authorities to undertake the duties of historian of the medical aspect of the recent disaster.

THE death is announced, at sixty-seven years of age, of Mr. J. E. Cullum, late superintendent of the Valencia Observatory, Ireland.

THE *Morning Post* announces the death, at thirty-nine years of age, of Mr. H. L. Burgess, medical secretary to the Advisory Medical and Sanitary Committee for Tropical Africa and to the Yellow Fever (West Africa) Commission.

THE annual meetings of the Institution of Naval Architects will be held on March 20–21, in the hall of the Royal Society of Arts. The Right Hon. the Earl of Durham, president, will occupy the chair. A gold medal will be awarded by the council to any person, not being a member or associate member of council, who shall at the forthcoming meetings read a paper which, in the judgment of the council, is deemed to be of exceptional merit.

WE learn from the January issue of the *Observatory* the announcements of the deaths of M. S. Javelle, astronomer at the Nice Observatory, and Dr. E. Kron, junior observer at the Potsdam Observatory. The following particulars of their careers are extracted from obituary notices in our contemporary:—M. Javelle was born at Lyons in 1864, and joined the staff of the Nice Observatory in 1884. He assisted Thollon in his solar researches and Perrotin in his double-star observations. In 1889 the great equatorial was placed in his charge, and remained so until his death. He made many observations of comets and minor planets, but his principal work was the discovery of more than two thousand faint nebulæ.—Dr. Kron was killed on October 24 last in Flanders, where he was serving as oberleutnant and battery commander. Born in 1881, after graduating at the Berlin University he was ap-

pointed assistant at Potsdam in 1906, and at first was engaged upon the measurement of the plates in the Potsdam zone of the Astrographic Catalogue. In 1910 he accompanied Prof. Müller on the Potsdam eclipse expedition to Teneriffe. His most important work was also carried out in conjunction with Prof. Müller—the photometric Durchmusterung of the polar zone $+80°$ to $+90°$. On the outbreak of war Dr. Kron was engaged upon this work, and also upon an important investigation of the absorption of rays of short wave-length in the earth's atmosphere, using a quartz spectrograph.

News of the death of Dr. Jean Clunet, a victim to typhus in Rumania, has recently reached us. The greater part of Dr. Clunet's scientific work was devoted to the subject of malignant disease. He was the author of "Tumeurs Malignes," a volume filled with new experimental data, mostly original, upon the forms and varieties of tumours, the evolution of neoplastic growths, and the action of X-rays upon malignant tumours, human and animal. Dr. Clunet devoted a great amount of labour to these latter investigations, and he was able to show the various stages of degeneration through which malignant cells pass after adequate exposure to X-rays. Perhaps his most important work was the production of malignant tumours in rats by exposing them to repeated doses of X-rays. On two occasions he produced tumours in rats which satisfied two of the criteria of malignancy, viz. histological conformation to malignant type of cell and successful propagation with other normal rats. Since the outbreak of war Dr. Clunet had served in a medical capacity, at first with his regiment, and afterwards in some special capacity at the Dardanelles, with the Serbian Army at Corfu, and finally upon a mission of hygiene to the Rumanian Army. His scientific publications during the war include "La jaunisse des camps et l'épidémie de paratyphoïde des Dardanelles" and "La relation des accidents nerveux émotionnels, observés chez les naufrages de la Provence." Dr. Clunet was made an honorary corresponding member of the Röntgen Society in 1913. Those who had the privilege of knowing him deplore the loss of a life so full of promise of deeds to come.

Kew Bulletin, Nos. 7 and 8, published together, are occupied entirely with a list of economic plants, native or suitable for cultivation in the British Empire. The list is prefaced by some introductory remarks by Dr. A. B. Rendle, keeper of the Department of Botany, British Museum, South Kensington, explaining the origin and object of the list. The suggestion of the publication of the list arose at the British Association meeting, 1916, of which Dr. Rendle was president of Section K, and as Kew contained so much economic information in its museums, its preparation there was most fitting. In the list many well-known and already cultivated plants are mentioned, and references are given to the more important papers dealing with particular products, but there are many little-known plants to which reference is made which may be of value for future developments. Under every plant the country of origin is given and some particulars of its use. The plants are arranged under the products they yield, such as fatty oils, gums, etc.; rubber, gutta-percha, and balata; drugs, dyeing and tanning materials; paper-making materials and timbers.

The botany and physical geography of the Holy Land are of considerable interest at the present time in connection with the campaign in Palestine, and the article on the subject from the pen of the veteran botanist, Mr. J. G. Baker, published in the *Gardeners' Chronicle* for December 22 and 29, 1917, is most opportune. Several good illustrations add to the interest of the text. Though so small a tract of country, the flora, owing to the diverse physical features, is remarkably rich, comprising some 4000 species, exclusive of the lower plants, such as mosses and fungi. Boissier's "Flora Orientalis" is, of course, the classic work on this region, and additions to the list have been made by Sir Joseph Hooker and Sir Daniel Hanbury. The subtropical region of the Jordan Valley and southern deserts contains many forms unknown further to the west. Then there is the flora of the rich loamy coastal plains, with the limestone promontory of Mount Carmel; the mountain region of Lebanon and Antilebanon, above 4000 ft., rising on Lebanon to 10,000 ft., and here, as in N. Africa, the familiar Arctic-Alpine plants, found so far south as the Caucasus, are not represented, though they extend through to the mountains of Central Asia and the Himalayas. Lists of the more interesting plants are given for the different regions. Palestine in its botany combines in a remarkable manner the characters of the East and the West, but the abnormal feature of the Jordan Valley and the Dead Sea, deeply excavated below sea-level, constitutes, both florally and geologically, its most interesting feature.

The Advisory Council of Science and Industry of the Commonwealth of Australia appointed in August, 1916, a special committee to consider the problem of worm nodule disease in cattle, which is a source of serious loss to the Australian meat industry. The report of this committee has now been published as Bulletin No. 2 of the Advisory Council. The bulletin includes a report on the occurrence of onchocerciasis in cattle and associated animals in countries other than Australia, and also a translation of an article by M. Piettre on bovine onchocerciasis in South America. Further sections deal with Australian investigations, some of which have been recently dealt with here. The committee makes recommendations for a generous provision of assistance for further investigations.

In the *Journal of Agricultural Research* (vol. xi., No. 7) Messrs. W. Moore and J. J. Willaman give an account of studies in greenhouse fumigation with hydrocyanic acid. Evidence was obtained that the fumigated plants absorbed more or less of the gas, which led to a reduction in the activity of the oxydases and catalase, and, hence, in respiratory activity. This resulted further in an inhibition of photosynthesis and translocation of carbohydrate, and a closing of the stomata. Another result was an increase in the permeability of the leaf septa, with consequent less rapid intake of water from the stems and more rapid cuticular transpiration. In cases of mild fumigation this resulted in merely a temporary wilting, and the subsequent recovery was followed in many cases by a rate of growth and of fruit production (in the tomato) in excess of the normal. Within a few hours after fumigation oxydase activity had returned to normal, while the catalase and the respiratory activities exceeded the normal. By this time the recovery of photosynthetic action was first apparent; complete recovery, however, of this and of translocation of food material was not attained until after an interval of from two to three days. Respiration remained above normal for several days. The stimulation of growth may be due to at least two factors—namely, to the increased activity of the catalase and to the increased permeability of the cell-walls, allowing readier exchange of food materials and of gases. It is very improbable that the extra nitrogen contributed by the cyanide exercises any direct nutritive effect.

IN a paper which has appeared in the Proceedings of the Tokyo Mathematico-Physical Society (1916, p. 513, and 1917, p. 208) Prof. H. Nagaoka has taken up the theory of the concave grating in order to determine the errors introduced when a wide grating is used. He finds that the resolving power of concave gratings is far less than that of flat gratings of the same width. As, however, the utilisation of the whole power of a plane grating necessitates the use of a collimating telescope of large size, the best plan seems to be to construct concave gratings of very small curvature. The results of investigations of the structure of spectral lines with the concave gratings hitherto available have been inferior to those obtained by interference methods giving the same resolving power. But the latter methods are in turn subject to the drawback that the order of the spectrum for a particular constituent observed may not be identical with that of the principal line of the group under investigation.

AT the meeting of the Scottish Meteorological Society on December 20 last, a paper was read on ground-ice by Dr. John Aitken. It was pointed out that as ice cannot begin to form unless the water is cooled 2° or 3° below freezing point, any radiation effect from the bottom of rivers could never start the freezing there. An experiment was described in which ice was formed in running water by the action of radiation and cold air. The ice so produced was in small crystals, or frazil-ice, and was found attached to the bottom and to obstructions in the stream, the same as observed in rivers. This ice, when massed, was of a soft, spongy nature, like ground-ice. Observations made where there is ground-ice show that the very slight heating of the sun's rays soon causes it to loose its attachment to the bottom and rise to the surface. It is shown that this is due to the ice crystals slipping when the temperature is just above freezing point, and adhering when it is just under it. The difference measured on the thermometric scale is infinitesimal, though the physical results are enormous. While frazil-ice gives great trouble by adhering to the hecks of inlets at power stations, none has been experienced from it adhering to the guide-blades in the turbines. This difference, it is pointed out, is due to the water at the inlets being on the cold side of the freezing point, while in the turbines it is just above it, owing to its being under greater pressure and the ice melting.

PROF. M. TIFFENEAU informs us that the first volume of the correspondence of Charles Gerhardt, the centenary of whose birth was celebrated by the Chemical Society of France in December last, will be published in a few weeks' time. This volume will contain fifty-eight letters from Auguste Laurent and twenty from Gerhardt, between the dates 1844 and 1852. It is hoped that two other volumes of Gerhardt's correspondence will appear during this year. The complete work will contain five hundred letters exchanged, for the most part, with the chief chemists in Europe during a period—1837 to 1856—which, from the point of view of chemical science, was of the highest historical significance. The publisher of the three volumes will be M. P. Masson, 120 boul. Saint-Germain, Paris, and the price will be about fifteen francs per volume, or thirty-two francs for the set if this sum is subscribed before the end of the present year.

ONE of the difficulties with which railway maintenance engineers have to contend is creeping of the rails in a longitudinal direction, which necessitates periodic rectification of the position of the rails after the creep has taken place. Two papers were read on this subject at the Institution of Civil Engineers on January 8. In one of these papers Mr. H. P. Miles describes investigations of this phenomenon made by him for a period of five years in this country on a line consisting of 850 track miles of main and branch lines, over which various kinds of traffic passed. In the other paper Mr. F. Reeves describes some simple experiments he has carried out on pine, iron, and rubber laths by causing loaded wheels to roll along them. He concludes that creep is due primarily to deformation of the rail as the wheel passes over it, and that the more violent the deformation, the greater will be the creep; thus creep is increased by increasing the wheel load, and also by diminishing the rigidity of the rail, either by reducing its section or by using a weaker material. The weight of the wheel appears to be the most powerful factor affecting the amount of creep. Creep is accentuated by braking, and is greater down-hill than up-hill, but is by no means absent on the latter. Creep is always with the traffic. Creep can be resisted more or less completely by putting in enough anchorage or resistance, and Mr. Reeves describes several such devices, including one of his own design which is in use on the Buenos Ayres and Pacific Railway. Many railway structures are affected by creep, and their design should take it into consideration. This requires special emphasis in the drawing office.

OUR ASTRONOMICAL COLUMN.

THE MASSES OF THE STARS.—The masses of all the double stars for which sufficient data are available have recently been calculated by Prof. H. N. Russell (*Popular Astronomy*, vol. xxv., p. 666). The results for the mean mass of a pair of stars, grouped according to the spectral classes of the bright components, are summarised in the following table, the unit being the mass of the sun:—

Spectrum	Spectroscopic binaries No.	Spectroscopic binaries Mass	Visual binaries No.	Visual binaries Mass	Physical pairs No.	Physical pairs Mass	From parallactic motions No	From parallactic motions Mass.
B0–B5	13	17·5			8	10·4	36	7·1
B8–A5	18	4·0	6	5·9	12	3·0	114	8·4
F–G "giant" ...	34	3·9					37	8·1
K–M ,, ...							38	9·8
F–F5 "dwarf"...			17	3·5	9	3·4	60	2·5
F8–K0 ,, ...			21	1·8	10	1·4	51	0·7
K5–M ,, ...			4	0·7	8	1·0		

The first three groups present quite independent data, but the fourth, though for the most part independent, includes stars of the second and third groups. The giant stars of all spectral classes are thus shown to be nearly equal in mass, as they are in brightness. Among the dwarf stars, however, where the luminosity falls off rapidly with increasing redness, the mean mass also falls off, but much more slowly. The masses of the stars thus seem to be more closely related to absolute magnitudes than to spectral types; that is, the brighter stars are the more massive. This result is in accordance with Prof. Russell's view that only the more massive stars can attain great luminosity in the course of their evolution.

THE SPECTRUM OF α CANUM VENATICORUM.—It was discovered by Belopolsky a few years ago that certain lines in the spectrum of α Canum Venaticorum were alternately visible and invisible, and the same observer found later that such lines could be arranged in two groups. In a brief report in *Popular Astronomy* (vol. xxv., p. 656) it is stated that the spectrum has been further investigated at the Detroit Observatory by Mr. C. C. Kiess, who has obtained sixty-seven photographs, and has determined the wave-lengths of more than two hundred faint lines. The star is classed

as Ap. Belopolsky's groups have been verified and added to, and the lines have been respectively identified with those of europium and terbium. Many of the lines not definitely recognised as being of variable intensity have further been found to agree with the stronger lines of yttrium, lanthanum, gadolinium, and dysprosium. The peculiarities of the spectrum thus appear to arise from the exceptional development of lines belonging to rare earths. It may be added that the presence of europium lines in this spectrum was first detected by Mr. Baxandall, of the Solar Physics Observatory, Cambridge.

THE SOCIETY FOR PRACTICAL ASTRONOMY.—The annual report of the president of this society for 1916–17 is included in the *Monthly Register*, vol. ix., No. 2 (1338 Madison Park, Chicago, Ill.). The chief purpose of the society is to promote the practical study of astronomical phenomena, and to encourage co-operation among its members through the various observing sections which have been organised. A section for the teaching of astronomy, under the direction of Dr. Mary E. Bird, appears to have been especially successful. There is also a section for the construction of astronomical instruments, which is directed by Prof. M. F. Fullan, who is contributing a valuable series of articles on the construction of a Newtonian reflector, from the grinding and figuring of the mirror to the actual mounting of the telescope.

BUTTER SUBSTITUTES.

THE present shortage of fats, especially butter, gives a particular interest to two papers published by the Society of Chemical Industry. The first, printed in the Journal for October 31 last, is by Dr. A. Lauder and Mr. T. W. Fagan, who experimented on the utilisation of fatty acids for feeding purposes. The large increase in glycerol manufacture for explosives has resulted in the production of a quantity of fatty acids much in excess of what can ordinarily be utilised. According to the view now held of the digestion of fat in the animal organism, there does not seem to be any physiological reason why it should not assimilate free fatty acids. In the authors' experiments ten young pigs (about seven weeks old) were fed, the first five on a mixture of maize meal and sharps, the remaining five on a smaller ration of the meal and sharps mixture, together with a small quantity of the fatty acids from coconut oil. About 5 oz. of the fatty acids replaced 1 lb. of the meals. In addition to the above rations, a certain quantity of cabbage was given to the pigs. The results showed that the increases in the live weights of the two lots of pigs when the experiment had lasted for seven weeks were practically identical. The conclusion is drawn that the fatty acids were assimilated, and that they replaced about two and a half times their weight of carbohydrate.

The second paper, published in the issue of December 15, by Mr. W. Clayton, deals with "Modern Margarine Technology." The first butter substitute was prepared at the time of the Franco-Prussian War by Mège-Mouriès, who digested animal fat with sodium carbonate solution in the presence of pepsin (from pig or sheep stomach), the product being afterwards churned with 10 per cent. of cow's milk and water containing macerated cow's udder. In modern margarine manufacture the fat is no longer artificially digested with pepsin, whilst animal fat is more and more being replaced by vegetable oils (coconut, palm-kernel, cotton-seed, arachis, soja-bean, sesame, kapok, maize, and wheat), and by hardened or hydrogenated oil. It has been established that the very small quantity of nickel which remains in the hydrogenated oil is quite harmless. In the preparation of margarine milk is used for two primary reasons: first for flavouring purposes, and secondly as an emulsifying agent. The milk is pasteurised by heating at 82° C. for a few minutes (a possible improvement would be to sterilise it by means of ultra-violet light or a high-tension alternating current), cooled to 10° C., and delivered into souring tanks. In the latter it is inoculated with lactic acid bacilli and the temperature then raised to the point favourable to lactic fermentation. When the fermentation has proceeded so far that the acidity causes a rapid precipitation of curd the milk is again cooled to a safe inhibiting temperature. The mixture of vegetable and animal fats and oils is melted, strained, and brought to a suitable temperature (best 25° C.–35° C.). It is then run into a churn containing the prepared milk (the milk is sometimes added to the oil, but then emulsification is not so good), and the mixture emulsified by the action of revolving baffle-plates. The emulsion is allowed to flow on to a slanting shoot, where it meets a spray of ice-cold water. This causes immediate solidification and a breaking up of the mass into yellow granules. These granules, after draining, are kept at a constant temperature in a maturing room, where the bacteria introduced by the milk can develop. Maturing takes longest in the case of the best animal margarines. When mature the product is kneaded to form a coherent butter-like mass and to expel the excess of moisture, and then passes to the blending department, where it is prepared for sale. Boric acid (not exceeding 0·5 per cent.) is generally added as a preservative. Lactic fermentation imparts to the milk a pleasant acid taste, but does not give it the true butter flavour. Much research will be necessary before margarine can be made with a taste like that of butter.

E. H.

SEA-PENS OF THE "SIBOGA" EXPEDITION.[1]

THE Pennatulacea of the *Siboga* expedition—the richest collection of sea-pens made by a single expedition—comprise about 550 specimens, which Prof. Hickson has referred to seventeen genera and forty-five species (seventeen new). Having at his disposal this wealth of material, and other specimens in his own collection and in that of the University of Manchester, Prof. Hickson has taken the opportunity of making a thorough survey and revision of the order. He regards the order as consisting of only a few well-marked generic groups, and considers that new generic names should not be introduced without very strong reason. No new generic name is proposed in this memoir, and several recently described genera have been merged in older ones. Prof. Hickson carefully defines the descriptive terms employed in his memoir in the hope that henceforward there may be a greater measure of uniformity in the terminology; certainly he has set a high standard of precision in the systematic descriptions.

In the course of interesting speculations on the hypothetical ancestor and the evolution of sea-pens, Prof. Hickson says he is inclined to believe that Cavernularia is nearer the ancestral form—which he suggests was a dimorphic Alcyonacean similar in build to *Sarcophytum trochiforme*—than Lituaria, which Prof. Kükenthal considered to be the most primitive sea-pen.

Pennatulacea were obtained by the expedition from sixty-five of the 322 collecting stations, and the names

[1] "The Pennatulacea of the *Siboga* Expedition, with a General Survey of the Order." By Prof. S. J. Hickson. Pp. x+265+plates x+1 chart. (Leyden: E. J. Brill, 1916.) Price [illegible] francs.

of the species are printed on a large chart adjacent to the stations at which they were collected. Prof. Hickson directs attention to the rich harvest of sea-pens gathered around Amboyna, the Banda and Kei Islands, and off the south coast of Timor and Flores, and concludes that the Malayan region is the headquarters of the genera Pteroeides and Virgularia. He remarks that, although there is not sufficient information in regard to other genera to justify a similar conclusion, the facts as they stand are in accordance with the view that the Malay Archipelago is, or has been, a distributing centre of the Pennatulacea of the world. Of special interest from the point of view of geographical distribution is the occurrence of the following, all deep-sea forms: *Chunella gracillima*, previously known from the east coast of Africa; the genus Gyrophyllum, hitherto recorded only from the North Atlantic; and five species of Umbellula.

Anatomical and histological investigations have been made on a number of interesting points, *e.g.* (i) the ciliated radial canals, found throughout the rachis of Virgularia, which Prof. Hickson suggests are concerned with the flow of water into and distension of the colony; (ii) the large mesozooids of *Pennatula murrayi*, the structure of which indicates that they bring about rapid expulsion of water from the principal canals; (iii) the brown ciliated tubes of this species; and (iv) the gonads—all the species examined proved to be diœcious and oviparous.

Useful keys are given to the families, genera, and species, and the memoir is illustrated by ten plates and forty-five text-figures.

Prof. Hickson is to be warmly congratulated on the completion of this important memoir, which is characterised throughout by great care and sound judgment.

EXPERIMENTAL HYDRAULICS.[1]

THE small amount of evidence, which many engineers are willing to accept as satisfactory proof of some principle or empiricism used in connection with their designing, is sometimes surprising to those who combine, with engineering experience, knowledge of the more refined and rigid methods of scientific inquiry. Perhaps there is no more striking evidence of this than in connection with the formulæ used by engineers, in perfect faith, to determine the flow of water over weirs and through orifices and nozzles.

Very frequently in experimental work there is a want of precision in the results, owing to lack of appreciation of what might be called the persistence of hydraulic disturbance. In our technical colleges apparatus which is supposed to compare the loss of head in certain lengths of pipes of different form, and certainly measures something, but not that which the designer intended, is not infrequently used by students.

It is to be regretted that so little attention has been paid in this country to precise experimental hydraulics; but because of that we are so much the more indebted to those workers who, in France and the United States, have added to our experimental knowledge of this important subject.

The modern universities of the United States are issuing from their experimental stations many interesting Bulletins describing the results of special researches, and Bulletin 96 of the University of Illinois, though not by any means ambitious, is yet of sufficient importance to receive a passing notice in the columns of NATURE. It describes experiments on the effect of fixing mouthpieces of different shapes on the discharge through a short drowned pipe. The apparatus is described, and the coefficients of discharge for a six-inch short pipe without mouthpieces at either end, and with the inlet projecting and not projecting inwards respectively, as well as for different combinations of mouthpieces at inlet and outlet, are given. A bibliography of the subject is attached to the paper.

[1] "The Effect of Mouthpieces on the Flow of Water through a Submerged Short Pipe." By F. B. Seely. Bulletin No. 96. (University of Illinois.)

ASTRONOMICAL CONSEQUENCES OF THE ELECTRICAL THEORY OF MATTER.[1]

CERTAIN complications have recently been introduced into theoretical physics or physical philosophy which, though not of immediate application to engineering, should have an interest for all educated people.

The doctrine of relativity is based essentially on two negative experiments. One of these was conducted by me at Liverpool, and is fully recorded in the Philosophical Transactions of the Royal Society for 1893 and 1894. The outcome of the experiment is to show that the velocity of light is not affected in the neighbourhood of rapidly moving matter; thus, in language appropriate to æther, implying that the æther is stationary in space and cannot be carried along by moving matter; that there is no viscous or frictional drag between matter and æther. The other and more famous experiment is that of Michelson and Morley, which proves that the time of a light-journey to and fro between points fixed to the earth is not affected by azimuth; which therefore appears to imply that the earth is not moving freely through the æther, as the first experiment requires, but that the adjacent æther is stagnant with respect to the earth's surface, as if a layer of some thickness were fully carried along with the earth in its motion through space.

(I must here say that this is a conclusion which, if admitted, would involve many difficulties, and would complicate the relation between æther and matter amazingly.)

The two experiments are thus contradictory, suggesting that the wording of the conclusion in terms of æther may be wrong, and inasmuch as all experiments on the æther have so far given negative results except when there was some movement of matter relative to matter, a doctrine of relativity has arisen which begins by postulating that such experiments always will give negative results, that the properties of an æther can never be ascertained, that things go on as if space were empty; that movement of matter has no meaning except with reference to other matter, and hence that in all probability the æther does not exist. I ought perhaps to make it clear that I myself do not hold this doctrine; but on that subject I have expressed my own position in my British Association address, published by Messrs. Dent and Sons under the title "Continuity."

How the velocity of light, which is an undeniable and metrical fact, can thus be understood or systematised, without a medium possessed of definite physical properties, seems to conservative physicists a substantial difficulty at the outset. Nevertheless, they are willing to admit that questions directly addressed to the æther have always received negative replies: always except once—the measurement of the finite and definite velocity of light, both in free space and in transparent matter. Beyond this, the three salient optical phenomena—viz. the Bradley aberration, the Fizeau convection, and the Doppler change of frequency—all involve motion of matter relative to matter.

[1] Abridgment of a lecture delivered to the student-members of the Institution of Electrical Engineers on November 23, 1917, by Sir Oliver Lodge, F.R.S.

To get either aberration or Doppler effect the receiver must move relatively to the source; to get the Fizeau drift there must be a material medium transmitting the light, and that medium must be in motion with respect to both source and receiver.

We must admit, however, that if the æther is to be sustained as a reality, some way out of the contradiction of the two experiments first cited must be found. Such a way out was suggested by G. F. FitzGerald, and shortly afterwards independently by Prof. H. A. Lorentz. It consists in supposing that the shape of bodies is slightly dependent on their motion, so that a sphere moving through the æther in the direction of its polar axis becomes an oblate spheroid with a contracted axis, or a slightly swollen equator, or both. Such a change of shape, if applicable to all matter without exception, would be, ordinarily speaking, undiscoverable, but would account for the negative result of the Michelson experiment without any appeal to the principle of relativity or any abandonment of the æther of space; for the to-and-fro journey along the line of motion could then be considered shortened by the requisite amount, so that the time taken by light to travel in what for brevity we may call the axial direction (nothing to do with the axis of the earth) need be no longer than that taken to travel equatorially, in spite of its having to go in one case against and with the stream, and in the other case across it.

Thus with this special hypothesis the Michelson-Morley observation would be justified, even though the æther were streaming at full speed past the earth, no part of it being carried along with that body, entirely in accordance with the first experiment above cited. This would have the incidental advantage of rendering the theory of Bradleyan aberration quite simple and straightforward, and it would help us to begin to understand the relationship between æther and matter.

The amount of longitudinal contraction necessary is very small; the two-hundred-millionth part of the relevant dimension would suffice, a fraction corresponding with only $2\frac{1}{2}$ inches in the diameter of the earth; and Lorentz showed that on the electrical theory of matter such a contraction was quantitatively to be expected,[2] viz. an amount $\sqrt{\left(1-\frac{v^2}{c^2}\right)}$.

The Electrical Theory of Matter.

The electrical theory of matter took its rise about 1881 in some brilliant work of Sir J. J. Thomson, who showed that an electrical charge conferred on the body possessing it a slight extra inertia in excess of its ordinary mass.

The electric inertia thus gained by a sphere of radius a charged with quantity e was

$$\frac{2\mu e^2}{3a};$$

though this, when interpreted in micrograms, seemed hopelessly too small for any possibility of observation.

The extra, or electrical, inertia was due to the magnetic field excited by the motion of the charge, and was of the nature of self-induction; it reacted against acceleration or any change of velocity quite in accordance with Lenz's law. The magnitude of this inertia depends on the concentration of the lines of force, or, as we may express it, on the potential of the charge, and is proportional to its potential energy. The potential is $e/\kappa a$; the energy is half the charge × the potential; so the expression for the inertia may be written as the static energy of the charge multiplied by $4/3c^2$, where c is the velocity of light. Hence the obvious smallness of the result.[3]

Some time later, viz. in 1887, Mr. Oliver Heaviside calculated that this electric inertia was not precisely constant, but must be a function of speed, and gave an expression for it at any velocity, incidentally showing that it tended asymptotically to an infinite value at the velocity of light.

Then Sir Joseph Larmor showed that the FitzGerald-Lorentz contraction corresponds with this extra inertia, by an increased concentration of the electric lines of force to the equator of a moving sphere, when by reason of motion it becomes deformed into an oblate spheroid.

All this, however interesting, seemed rather academic and without probable realisation in practice, until in 1899 Sir J. J. Thomson isolated the unit electric charge and discovered that it could exist apart from matter, and was of excessively minute bulk even when compared with a single atom.

The apparently insignificant expression, $2\mu e^2/3a$, now came into prominence, for the small size of an electron would mean excessive concentration of the lines close to the centre of force, and therefore a perceptible amount of inertia, even though the charge itself were small. The inertia of electrons was actually measured by ingenious vacuum experiments.

The inertia of light-emitting particles was also measurable, by aid of the Zeeman effect, and was found to be the same; and many other measurements of electric mass were made and found consistent.

Later, as we know, the speed of extra quick-moving electrons was measured, and their predicted extra inertia at high speed was verified and found to be correctly accounted for by electrical theory, on the assumption that their whole mass was electrical.[4]

Hence the speculation became reasonable that possibly there was no inertia in existence other than electric inertia, and that the electromagnetic phenomenon with which we had been familiar ever since Faraday and Maxwell, and had known for a long time as *self-induction*, was truly the basis of all inertia, and might be held to account for, and partly to explain, the most fundamental property of matter.

Thereupon arose various semi-astronomical speculations as to the nature or structure of an atom, the most probable of which at the present day assumes a central positively charged nucleus, of possibly complicated structure, surrounded by an equal opposite group of negative electrons revolving with intense rapidity in regular orbits and subject to various known kinds of perturbation, the number of electrons per atom in any given instance being determined by the numerical position of the substance in the chemical series of elements.

Assuming, then, that the familiar mechanical inertia of all matter is wholly electrical, we may summarise results by saying that when stationary in the æther its mass is the sum of terms like

$$m_0 = 2\mu e^2/3a,$$

but that when moving with velocity v, bearing a cer-

2 In my British Association address "Continuity" I indicate a preference for a slightly modified change of this kind (see pp. 58 and 111), whereby the volume of a moving spherical unit remains unchanged, the polar axis shortening $\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{3}}$, while the two equatorial axes, *i.e.* those perpendicular to the motion, lengthen $\left(1-\frac{v}{c^2}\right)^{+\frac{1}{6}}$. This does all that is necessary, and evades some difficulties. It is, on the whole, sustained by some experiments of Bucherer.

3 For example, a sphere 40 centimetres in diameter, charged to a potential of, say, 300,000 volts, would have an electrostatic energy of ten million ergs, and an electrical inertia, or extra mass due to its charge, of $\frac{1{\cdot}33\times 10^7}{9\times 10^{20}} = \frac{1}{7}\times 10^{-13}$ gram, or the seventy-thousand-millionth part of a milligram.

4 See Sir J. J. Thomson's interpretation of Kaufmann's results, as given, for instance, in "Conduction of Electricity through Gases," p. 535; or in my book on "Electrons," p. 134.

tain ratio to the velocity of light c, each of these terms becomes

$$m = m_0\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} = m_0 \sec\beta,$$

where $\sin\beta$ represents [5] the ratio v/c.

Astronomical Applications.

Since inertia is a function of speed, it becomes a question whether some astronomical perturbations may not thus be produced and accounted for. This problem I attacked in the *Philosophical Magazine* for August, 1917. It is true that the motion of planets is slow compared with the speed of light, but it is immensely quicker than that of cannon-balls or of any artificial movement that we can cause on earth. Moreover, the effects, if any, may perhaps turn out to be cumulative, and it is well known that the position of planets has now been observed for some centuries with prodigious accuracy.

The quickest moving planet is Mercury, and since it makes four journeys round the sun every year, there is some reasonable chance of perceptible accumulation of small effects in a moderate time. Now there is known to be an interesting historical outstanding discrepancy in the motion of Mercury which the theory of gravitation fails to explain.

The orbit of any planet or satellite subject to a perturbing cause, such as the attraction of a third body, was shown by Newton to rotate in its own plane, the position of its perihelion changing slightly at each revolution. In most cases gravitation can account for the whole of this progress of perihelion; but the orbit of Mercury had been by careful measurement proved to revolve some forty or, more carefully estimated, forty-three seconds of arc per century more than could be accounted for by any known gravitative perturbation. It is not much, but it is reckoned unmistakable—no one questions the fact—and many attempts have been made to explain it.

Leverrier invented an intra-mercurial planet, Vulcan, to account for this progress of the perihelion of Mercury's orbit; but no such imaginary planet has ever been seen. Other astronomers have surmised that the law of gravitation might be slightly inaccurate; or, again, that the force of gravity travelled at a finite speed. Recently Einstein has applied the theory of relativity to the problem, and by extremely complex reasoning has arrived at the required result.

It remains to see whether without any of those efforts the straightforward and simple electrical theory of matter cannot account for the observed progression.

Hitherto the attempt has been made to tamper with the force acting on the planet; we now leave the force alone and tamper with the planet's inertia, as increased by its motion through the æther, and varied by any variations in that motion.

The whole solar system is known to be travelling among the stars; and sometimes the motion of a planet as it revolves round the sun will agree in direction with a component of the solar drift, while at other times—*i.e.* in the other half of its orbit—the planet's orbital motion and a component of the solar drift will be in opposite directions. Thus the absolute or resultant speed of the planet through the æther will vary, and hence, on the electrical theory of matter, its effective inertia will vary too.

It remains only to calculate what the effect of this varying inertia will be, given any reasonable value for the sun's true motion through the æther of space.

The resultant speed of the planet is to be reckoned as

$$\sqrt{(v^2 + V^2 + 2vV\cos\phi)},$$

where ϕ is the angle made by its motion v, at any instant, with V, the solar drift. This last has a component θ in the plane of the orbit, such that $\cos\phi = \cos\lambda\cos\theta$, θ being the longitude and λ the latitude of the sun's true way referred to the direction of the orbital motion v. So, expressing mass as a function of velocity in the ordinary equation of particle dynamics for any central force,

$$\frac{d^2u}{d\theta^2} + u = \frac{F/m}{h^2u^2}$$

where u is written for $1/r$ in ordinary polar co-ordinates, the mass will depend on phase, and will be found to contain a factor $1 + \cos\theta$.

Introducing this factor due to varying inertia into the above differential equation, I found it to take a form familiar to electricians, viz.:

$$\ddot{x} + \kappa\dot{x} + n^2x = E\cos pt,$$

or, rather, a special case of this, with $\kappa = 0$ and $n = p$. In other words, it represents the case when free and forced vibrations are of exactly the same period, and undamped; it is the equation of perfect resonance. The solution accordingly shows a steadily increasing amplitude, without limit, as time goes on,

$$x = \frac{E}{2n}t \,.\, \sin nt.$$

In the same way the astronomical problem exhibits accumulation or resonance as regards progress of perihelion, the perturbation being essentially synchronous with the phases of orbital revolution; and accordingly after the lapse of, say, a century, the minute perturbation due to fluctuating inertia, even though so small as one-tenth of a second per revolution, may have accumulated in the course of a century to the still small, but very perceptible, value of forty-three seconds of arc. Moreover, the kind of perturbation caused by fluctuating inertia, as expressed by the equation worked out in the August, 1917, *Phil. Mag.*, turns out to be exactly the kind of perturbation required, viz. a revolution of the orbit in its own plane; and it will be of the right value provided the true or real solar drift has a component equal to twice the earth's orbital velocity in a direction parallel to the minor axis of the planet's orbit.

The progress of perihelion of a planet's orbit, after n revolutions, comes out, according to this simple theory,

$$d\varpi = \frac{\pi n v V\cos\Phi}{ec^2},$$

where v is the average speed of the planet, and e the small eccentricity of its orbit; the unknown solar drift is V, in a direction making an angle Φ with the minor axis of the orbit; and c is the velocity of light.

Assuming a drift of the above value, such as is required for Mercury, I proceeded to try its effect on Mars, and, as is shown in the August *Phil. Mag.*, found that it caused Mars's perihelion to revolve seven seconds of arc per century; which, I learn, is considered by astronomers to be the outstanding discrepancy for Mars.

[5] When velocity is constant, as it is during purely transverse or centripetal acceleration, the effective or transverse inertia is simply $m_0 \sec\beta$, being greater than the slow speed or rest inertia in the inverse ratio $\sqrt{\left(1 - \frac{v^2}{c^2}\right)}$, as stated above; but when velocity is increasing or decreasing by reason of a longitudinal force, we can write the conditions thus:

$$v = c\sin\beta$$
$$m = m_0\sec\beta$$
$$mv = m_0c\tan\beta$$
$$\text{and } F = \frac{d(mv)}{dt} = m_0c\sec^2\beta.\frac{d\beta}{dt}$$
$$= m_0\sec^3\beta.\frac{dv}{dt}$$

so that high-speed longitudinal inertia is $m_0\sec^3\beta$, and is greater than the slow speed or rest inertia in the ratio $\sec^3\beta$, or, what is the same thing,

$$\left(1 - \frac{v^2}{c^2}\right)^{-\frac{3}{2}};$$

and is also, curiously, greater than the transverse inertia at the same speed, in the ratio $\sec^2\beta$.

Prof. Eddington, however, in succeeding issues of the *Phil. Mag.* (September and October, 1917), has now applied my theory to the Earth and Venus, and shown that according to it either their orbits must revolve, or their eccentricities must be affected, to an extent small indeed, but greater than is astronomically allowable. Also that there will be unpermissible variations of eccentricity for Mercury and Mars. Hence the whole matter is *sub judice*, and the last word has not been spoken.

Conclusion.

Finally, it is necessary to say that this astronomical application of the electrical theory of matter—at any rate as given here—assumes that the extra or spurious inertia due to motion is not subject to gravity. If it is a portion of the true mass, and as much subject to gravitational pull as all the rest of the inertia, then it would seem that there should be no perturbation at all,[6] for weight and mass will be still accurately proportional.

But certain analogies suggest to me that in all probability the part of inertia dependent on motion is due to æthereal reaction and is not likely to add to the body's weight.

Until we have some theory as to the nature of gravity we cannot definitely pronounce on such a point, though meanwhile the success or otherwise of the above astronomical application may tend to bear some testimony on this very point. If the calculated perturbation does not exist, it may mean either that the inertia of matter does not vary with speed as electrical theory predicts, or else that every kind of inertia, however caused, is fully subject to gravity, which in itself would be a momentous conclusion. In that case (I may say incidentally) the deflection of a ray of starlight grazing the sun or other large body is decidedly to be expected, the deflection being probably $2gR/c^2$; where the g and R are solar.

We must, however, anticipate that if the ultimate conclusion does turn out negative, and if, taking all the planets into consideration, no such set of perturbations as is here foreshadowed can be really allowed, it will be claimed as one more negative answer returned by the æther. And we must regretfully admit that every negative answer tends (at least temporarily) to strengthen the apparently growing faith in that complex and perturbing view of the relation between space and time and matter which is known as the Principle of Relativity.

[6] I have since seen reason to modify this at first sight obvious opinion, and have more to say on this subject; probably in the *Philosophical Magazine* for February, 1918.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Two Theresa Seessel research fellowships, to promote original research in biological studies, are offered in competition by Yale University. The fellowships are open to men or women, and each is of the value of 200*l*. Applications, accompanied by letters of recommendation, reprints of scientific publications, and a statement of the particular problem which the candidate is prepared to investigate, should reach the Dean of the Graduate School, New Haven, Conn., U.S.A., before April 1 next.

The City Council of Rome has nominated a committee for the formation in Rome of an "Elementary School of Industrial Chemistry," with the view of "improving existing education on the subject and to arrange for new courses of instruction in this modern industry, which may have a great future in our city." The committee, according to *L'Economista d'Italia* for January 1, has already commenced work, and hopes to be able to conclude its deliberations during January, so that at the end of the present school year the school can begin its courses and take part at once in the professional culture of the Rome working classes and preparations for the after-war campaign in the city.

The annual meeting of the Mathematical Association was held on January 9 and 10. In his presidential address on "Mathematics and Individuality," Prof. T. P. Nunn maintained that the development of individuality is the only natural and reasonable ideal in education. He pleaded for much greater freedom for boys and girls in choosing both the distribution of their time and the lines along which their energies should be directed. The function of the teacher should be to "stand by," giving help in the form of guidance and advice, and, where necessary, teaching. This teaching should be partly collective as now, but to a large extent it should be given to individuals, or at least to small groups of pupils. In this way boys and girls, free to follow their own bent and to give scope to their natural impulses towards knowledge, would not only find much greater vividness and reality in their school work, but each of them would also be prepared to make later that unique contribution which he alone can make to the variegated whole of human life. Such freedom to each to make the best of his life in his own way is the source of all higher goods; education can accept no lower, and can find no higher, aim. In a newly constituted "advanced section" Dr. W. P. Milne read a paper on "The Graphical Treatment of Power Series." He urged, in teaching higher algebra, both the use of graphical and intuitional methods and the application of the calculus. Principal Hatton raised the question of the omission of mathematics from Section A of the new scheme for Class I. of the Civil Service Examination. After some discussion it was agreed to ask the Commissioners to add the words "and mathematics" to the title of subject 4 ("The general principles, methods, and applications of science") and to double the number of marks assigned to that subject.

A recent issue of the *Educational Supplement of the Times* included a translation of an article published in the Berlin *Lokalanzeiger* describing how the German working classes in particular would be reduced to a wretched condition if Germany were to lose this war, or even if it were to be obliged to conclude a peace of renunciation. That, the article urges, is not only applicable to the economic position of the German working classes, it may also be said to the same extent of the intellectual development of the masses of the people. That they will be the most severely affected if Germany is obliged to bear alone the burdens of war will clearly appear from a retrospect of what Germany has achieved until now in regard to popular education. The total financial needs of the German States amounted in 1910, apart from the expenses on behalf of the Imperial Army and the Navy, to about 150,000,000*l*.; 13·8 per cent. of this was expended for science and instruction, 8·9 per cent. on schools alone, and 7·1 per cent. on the people's schools. In 1911 the German States and municipalities raised together nearly 44,000,000*l*. for the schools, of which 33,500,000*l*. was for the benefit of the people's schools alone. That means, the article states, that in Germany per head of the population 13*s*. was expended, in England 8*s*., and in France 7*s*. "If in Germany until now more than 50,000,000*l*. was spent yearly exclusively for educational purposes, the question arises, the German writer continues, if these achievements

in future will be possible in the event of a peace of renunciation. Anyone able to make a cool calculation must answer promptly in the negative. Certainly even in that case we should not collapse if we had to bear our war burdens alone; but as to this one should be under no illusion—we should then have to economise everywhere for these purposes, whether we liked it or not, in order at least to maintain our present rate of development."

EDUCATION (No. 2) Bill was introduced by Mr. Fisher in the House of Commons on January 14, and read a first time. In explaining the new measure, Mr. Fisher said:—"The Bill which I now introduce is substantially identical with the measure familiar to the House. It imposes upon the councils of counties and county boroughs the duty of providing for all forms of education. It abolishes exemptions from school attendance between five and fourteen years of age. It provides for further restrictions upon the industrial employment of children during the elementary-school age, and for the gradual introduction of a system of compulsory day continuation classes for adolescents. In the new Bill, as in the old one, local education authorities are empowered to give assistance to nursery schools, and in other ways to help the physical and social welfare of the children committed to their charge. Indeed, attention to physical welfare is a special and distinctive note of both Bills. On the other hand, I have either omitted or amended certain of the administrative clauses." Clause 5, which provided for provincial associations, is omitted, and provisions are embodied in Clause 6 which will facilitate the federation of local education authorities for certain purposes, which was the governing principle of Clause 5. Some alterations have been made in the clauses dealing with the attendance at continuation classes and at nursery schools, and also in the clause dealing with the abolition of fees. Mr. Fisher added:—"A White Paper will be circulated so that hon. members may be able to see clearly the changes of substance introduced. I hope it will be recognised that the adoption of this course will facilitate the expeditious discussion of the Bill in Committee. I hope that as the result of the consultations and discussions which I have held with the local education authorities during the last few months, a large portion of the measure which might otherwise give rise to acrid debate may be taken as substantially agreed upon."

SOCIETIES AND ACADEMIES.

LONDON.

Röntgen Society, January 1.—Capt. G. W. C. Kaye, president, in the chair.—Dr. W. D. **Coolidge**: A "radiator" type of X-ray tube. The anticathode consists of a block of copper faced with a small button of tungsten. This is fixed to a thick stem of copper which passes out through the glass neck of the tube and terminates in a fin radiator. The anticathode is thus kept cool and does not in consequence emit electrons, as in the case of the earlier type of Coolidge tube in which the whole of the anode speedily becomes red-hot. The new tube, therefore, so completely rectifies current that when an alternating potential is applied the current will only pass in one direction.—Dr. W. D. **Coolidge** and C. N. **Moore**: The field X-ray outfit of the United States Army. A petrol-electric unit supplies alternating current at 110 volts to a transformer arranged to give both high-tension and heating currents for the new radiator type of Coolidge tube. For simplicity of control the tube is worked at a constant potential of 5 in. equivalent spark-gap, and the current is adjusted to 5 milliamperes for continuous running of the tube or to 10 milliamperes for short periods. An electrically actuated control on the throttle of the engine maintains constant output. The small size of the bulb, $3\frac{1}{2}$ in. in diameter, enables a close-fitting lead-glass shield to be employed. This is made in two parts, and completely surrounds the tube, a suitable aperture permitting egress of the useful rays.

Optical Society, January 10.—Prof. F. Cheshire, president, in the chair.—F. E. **Lamplough** and Miss J. M. **Mathews**: Relative dispersion and achromatism. The paper contained an account of an inquiry into the extent of the relation between the irrationality of dispersion in glasses and the mean dispersion and dispersive power. The work consisted chiefly in the reduction of observations made by Lt.-Col. J. W. Gifford on the refractive indices of thirteen spectral lines for thirty glasses. The results showed the absence of any accurate relations. It was found that in general the type of dispersion of a glass is determined by its dispersive power, but with a few special glasses mostly requiring protection an improvement could be effected on the achromatism secured by ordinary glasses of similar dispersive power. The problem of the triple objective was referred to.—J. **Guild**: A spherometer of precision. The chief feature of this instrument is the method employed for detecting the exact contact between the micrometer screw and the surface under test. The micrometer terminates in a small sphere of about 1·5 mm. diameter. A microscope with a suitable illuminating apparatus is mounted above, and the Newton's rings surrounding the point of contact are observed. By watching the behaviour of the rings when the screw is brought up, the exact point of contact is determined. The sensitivity is about one ten-thousandth of a millimetre.

PARIS.

Academy of Sciences, December 24, 1917.—M. Paul Appell in the chair.—A. **Lacroix**: The forms of the leucitic magma of the Lazial volcano. Fourteen complete chemical analyses of the various minerals are given, and the results are compared with those obtained from the rocks of the Somma.—Y. **Delage**: The mesorheometer, an instrument for measuring the velocity of water currents intermediate between the surface and the sea-floor. The special point of the apparatus described is a contrivance for damping the effects due to the oscillation of the boat.—G. A. **Boulenger**: The marine origin of the genus Salmo. A reply to some objections of Louis Roule.—M. G. Friedel was elected a correspondant for the section of mineralogy in the place of the late M. Vasseur.—G. H. **Hardy** and J. E. **Littlewood**: The convergence of Fourier's series and Taylor's series.—M. **Guillet**: Measurement of the intensity of the field of gravity. Galileo's pendulum and Newton's tube. Some advantages are claimed for Newton's tube over the pendulum, and details are given of the best construction of the former apparatus.—Mme. E. **Chandon**: A determination with the prism astrolabe of the latitude of Paris Observatory. The mean of the determinations is $48° 50' 11·21''$. This compares with $48° 50' 11·07''$, the mean furnished by several instruments between 1851 and 1892, and $48° 50' 11·3''$, a more recent determination (1890 to 1901) with the meridian circle.—A. **Veronnet**: The law of densities inside a gaseous mass. A study of the density curve of a star considered as wholly gaseous.—V. **Schaffers**: The sound of cannon at a great distance.—H. **Hubert**: The use of the stereoscope for the examination of superposed projections.—E. **Chéneveau**: A relation between the refractive properties and chemical constitution of fatty substances.—G. **Fouqué**: The separation of the secondary amines arising from the catalytic hydro-

genation of aniline. The crude mixture to be separated contains *cyclo*hexylamine, di*cyclo*hexylamine, *cyclo*hexylaniline, diphenylamine, and some secondary products, benzene, *cyclo*hexane, and tar. A scheme is given for the separation and isolation of the above amines.—G. F. **Dollfus**: Geological observations made in the neighbourhood of Honfleur (Calvados).—L. **Dunayer** and G. **Reboul**: The diurnal variations of the wind in altitude.—C. **Gessard**: An erythrogenic variety of the pyocyanic bacillus.—M. **Belin**: A new method of general chemicotherapy: oxidotherapy. A description of results obtained by the injection of solutions of potassium permanganate in tetanus, typhoid fever, acute rheumatism, and other diseases.

PETROGRAD.

Academy of Sciences, September 13, 1917.—E. E. **Kostyleva**: The forms of corrosion of topaz crystals from Šajtanka (Oural).—N. N. **Adelung**: Contributions to our knowledge of the Palæarctic Blattoidea. II.: Supplementary notes on *Ectobiella duskei*, Adel.—A. P. **Semenov-Tian-Šanskij**: Preliminary synopsis of the Mydaidæ of the Russian fauna (Diptera).—V. K. **Soldatov**: New genus of Zoarcidæ—Gymnelopsis, n.gen., and *G. ocellatus*, *G. brashnikovi*, *Lycenchelis armatus*, nn.spp., from the Okhotsk Sea.—N. M. **Krylov** and Ja. D. **Tamarkin**: The method of W. Ritz for the approximate solution of problems of mathematical physics.—P. P. **Lazarev**: The laws of transitory illumination of the retina in peripheral vision.—A. **Bačinskij**: Molecular fields and their extent.—M. **Kasterin**: The inconsistency of Einstein's principle of relativity.—N. V. **Nasonov**: The fauna of the Turbellaria of Finland.—I. N. **Filipiev**: Instructions for collecting free-living nematodes.—V. N. **Ipatiev** and V. **Verchovskij**: The solution of zinc in hydrochloric acid under high pressure.

BOOKS RECEIVED.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. iv., part 2. (Sydney: W. A. Gullick.) 2*s.* 6*d.*

Australasian Antarctic Expedition, 1911–14. Scientific Reports, Series C. Zoology and Botany. Vol. iv., part 2. Cephalopoda. By S. S. Berry. Vol v., part 1. Arachnida from Macquarie Island. By W. J. Rainbow. (Adelaide: R. E. E. Rogers.) 1*s.* and 3*s.* 6*d.* respectively.

A Short Course in Elementary Mathematics and their Application to Wireless Telegraphy. By S. J. Willis. Pp. 182. (London: Wireless Press, Ltd.) 3*s.* 6*d.* net.

Britain's Heritage of Science. By A. Schuster and A. E. Shipley. Pp. xv+334+illustrations. (London: Constable and Co., Ltd.) 8*s.* 6*d.* net.

The Linacre Lecture on the Law of the Heart. By Prof. E. H. Starling. Pp. 27. (London: Longmans and Co.) 1*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 17.

LINNEAN SOCIETY, at 5.—(1) Restoration of the Head of Osteolepis; (2) Femur of Pterodactyl from the Stonesfield Slate: E. S. Goodrich.—Some Early Cape Botanists: J. Britten.—A Hybrid Stachys: C. E. Salmon.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Incidence of Taxation upon Metalliferous Mining in the British Isles: H. Louis.—Molybdenum in Norway: E. R. Woakes.

MATHEMATICAL SOCIETY, at 5.—A Method or Studying any Convergent Series: Major P. A. MacMahon.—Additional Note on Dirichlet's Divisor Problem: G H. Hardy.—Note on a Diophantine Inequality: J. H. Grace.—Supernormal Curves: C. H. Forsyth.—A Note on a Theorem of Mr. Hardy's: K. Amanda Ran.—Plane Quartic Curves with a Tacnode: Prof. H. Hilton and Miss D. S. Tuck.

CHEMICAL SOCIETY, at 8.—The Synthesis of Ammonia at High Temperatures: E. B. Maxted.—Interactions of Formaldehyde with Urea: A. E. Dixon.—The Colouring Matters of Camwood, Barwood, and Sanderswood: P. O'Neill and A. G. Perkin.—Studies on the Walden Inversion. VII. The Influence of the Solvent on the Sign of the Product in the Conversion of β-Phenyl-α-bromopropionic Acid to β-Phenyl-α-aminopropionic Acid (Phenylalanine): G. Senter, H. D. K. Drew, and G. H. Martin.—Pure Piperidine Nitrate: A. K. Macbeth.—The Chemistry of Slightly Soluble Compounds of Thorium, as Investigated by Radio-active Methods: W. T. Spizine.

ROYAL SOCIETY OF ARTS, at 4.30.—The Tata Iron and Steel Works: H. M. Surtees Tuckwell.

FRIDAY, JANUARY 18.

ROYAL INSTITUTION, at 5.30.—Studies on Liquid Films: Sir James Dewar.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Traction on Bad Roads or Land: L. A. Legros.—Utility of Motor Tractors for Tillage Purposes: A. Amos.

SATURDAY, JANUARY 19.

ROYAL INSTITUTION, at 3.—The Chemical Action of Light: Prof. W. J. Pope.

MONDAY, JANUARY 21

ARISTOTELIAN SOCIETY, at 8.—The Category of Action in Indian Philosophy and its Value for Modern Thinking: Dr. F. W. Thomas.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—*Discussion:* Study of a Dune Belt: W. J. Harding King.

ROYAL SOCIETY OF ARTS, at 4.30.—High-temperature Processes and Products: C. R. Darling.

TUESDAY, JANUARY 22.

ROYAL INSTITUTION, at 3.—Palestine and Mesopotamia: Prof. Flinders Petrie.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Further Discussion:* Rail-creep: F. Reeves.—Creep of Rails: H. P. Miles.

WEDNESDAY, JANUARY 23.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL SOCIETY OF ARTS, at 4.30.—Water Power in Great Britain (with Special Reference to Scotland); Its Amount and Economic Value: Alexander Newland.

THURSDAY, JANUARY 24.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Graphical Solution for High-angle Fire: Prof. A. N. Whitehead.—Flocculation: Spencer Pickering.—Revolving Fluid in the Atmosphere: Dr. J. Aitken.—Ultra-violet Transparency of the Lower Atmosphere and its Relative Poverty in Ozone: Hon. R. J. Strutt.—The Pressure in the Solar Spectrum of the Water-vapour Band λ 3064: Prof. A. Fowler.—The Ultra-violet Band of Ammonia and its Occurrence in the Solar Spectrum: Prof. A. Fowler and C. C. L. Gregory.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Telephone Exchange Transfers and their Organisation: F. G. C. Baldwin.

FRIDAY, JANUARY 25.

ROYAL INSTITUTION, at 5.30.—The Motion of Electrons in Gases: Prof. J. S. Townsend.

SATURDAY, JANUARY 26.

ROYAL INSTITUTION, at 3.—The Chemical Action of Light: Prof. W. J. Pope.

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THURSDAY, JANUARY 24, 1918.

THE ELEMENTS OF REFRIGERATION.

The Elements of Refrigeration. A Text-book for Students, Engineers, and Warehousemen. By Prof. A. M. Greene, jun. Pp. vi+472. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 18*s.* 6*d.* net.

THIS book is another striking example of the thoroughness of American (U.S.) technical educational methods, as shown by many excellent text-books—the scientific, the applied scientific, and the practical (including cost) being combined in a manner quite refreshing to British engineering students.

The table of contents discloses an excellent arrangement of matter, viz.: (1) Physical phenomena; (2) methods of refrigeration; (3) thermodynamics of refrigerating apparatus; (4) types of machines and apparatus; (5) heat transfer, insulation, and amount of heat; (6) cold storage; (7) ice-making; (8) other applications of refrigeration; (9) costs of insulation and operating costs; (10) problems.

We think, however, this arrangement would have been further improved by placing the thermodynamic section just before the problems, particularly as the author is a little disconcerting in his detailed methods. Thus, on p. 55, we have the end of a number of formulæ dealing with the air machine. The last formula is numbered (62), and is given as follows:—

$$\begin{aligned} W_c &= Mc_p(T_2 - T_1) + m(q_2 + x_2r_2 - q_1 - x_1r_1) \\ &= Mc_p(T_2 - T_1) + m(i_2 - i_1) \end{aligned}$$

where W_c = work done in compressor.

The author then gives an example:—"To apply these formulæ, it is desired to cool a room to 0°, with cooling water at 60° F., and the data for 1 ton of refrigeration is [*sic*] to be found. With a 10° rise in the water, a 10° difference between air and cooler and a counter-current air-cooler, the temperature of the air will be reduced to 70° F. The air in the refrigerator will be −10° F."

In this problem the temperature differences are pure assumptions, but of the order generally employed by the practical man in his approximations. It would have been much better if the author had *either* kept such a problem for the last chapter, *or* taken a set of actually observed temperatures and then applied them in the formula, showing—and accounting for—the difference in the work done, as given by the formula, and the actual expenditure of energy as registered by the ordinary practical methods. If this had been done, the student would not get so hopelessly mixed between the refinements of a thermodynamic equation and the everyday approximations and assumptions of the engineer. It would further have shown the value of comparing the ideal with the actual.

It is interesting to note that the author in his tables has used the excellent material on the properties of NH_3, CO_2, and SO_2 provided by the Refrigeration Research Committee of the Institution of Mechanical Engineers (Sir Alfred Ewing, chairman). It is to be regretted, however, that he has not mentioned the recommendations of that committee respecting the unit of refrigeration.

The author states: "Refrigeration is usually measured in tons of ice-melting capacity per twenty-four hours. Since the latent heat of fusion of ice is 143·4 B.Th.U. per pound, according to the latest experiments, this unit means the removal of 286,800 B.Th.U. per twenty-four hours, or 199·2 B.Th.U. per minute."

The first of five specific recommendations of Sir Alfred Ewing's committee surmounts this difficulty of the "latest" value by suggesting "that the refrigeration produced by a refrigerating machine be expressed in calories per second." Standard conditions of temperature are then laid down in the report, and the term "rated capacity" is proposed, the following explanation being given: "Thus, a machine may be classed as having a *rated capacity of one unit* if it produces a refrigeration of one calory per second (say 342,860 B.Th.U. per day) in steady working under the standard conditions specified."

At the present moment each country takes its own unit, and as this country differs from the United States in the value of the ton (2240 lb. and 2000 lb.), initial troubles begin. Added to this is the fact that "ice-making capacity" (in addition to "ice-melting") is often used, while no two makers of refrigerating machines assume the same temperature differences.

The author should have informed his readers of these differences and put them on their guard, incidentally mentioning the British recommendations. In any case, we express the hope that this unit—one calorie per second—will become a universal standard. It is absurd for any standard or unit to be changing with the "latest" research results.

The most disappointing point in an unusually good book is to be found in the opening words of chap. vi., on "cold storage": "The purpose of cold storage is to prevent the development of life which would cause decay of living tissue; it is also used to prevent the development of living organisms." This statement is calculated to make our men of pure science see that it is time they took some interest in low-temperature effects and their practical application in the cold-storage industry. It further indicates the spade-work necessary to link up science with the preservation of foodstuffs; but, the gulf once bridged, the field of research opened out will be boundless, while the merchant and the engineer will be able to get correct fundamental ideas that will be of the greatest value in the development of an industry that is scientifically sound.

Despite the fact that the book is based on American practice, it should prove of great value to students of refrigeration in this country.

J. WEMYSS ANDERSON.

NEW GUINEA AS A CENTRE FOR PLANT DISTRIBUTION.

Dutch N.W. New Guinea. A Contribution to the Phytogeography and Flora of the Arfak Mountains, etc. By L. S. Gibbs. Pp. iv+226. (London: Taylor and Francis, 1917.) Price *12s. 6d.*

THE north-western portion of New Guinea is still a very little known region, owing to the great difficulty of penetrating into the interior mountains, which rise fairly abruptly from the coast to a height of 5000 ft. to 7000 ft.

The first collection of plants from this region was made by Lesson in 1824; Beccari collected there in 1872 and 1875; Gjellerup in 1912 made extensive botanical collections; and the most recent contribution to our knowledge of the botany of this interesting country comes from Miss L. S. Gibbs, who is well known for the important work she has done in investigating the flora of Mount Kinabalu, Borneo, in particular. The object of her travels in New Guinea was to study the flora of the Arfak Mountains and to compare it with that of Kinabalu and the mountains of Malaya on one hand, and with the Australian flora on the other. The account of her hazardous journey and her conclusions as to the affinities of the flora are of great scientific interest. Owing to New Guinea being so little known, its importance as a centre for plant distribution has never been properly realised. Interest has always been concentrated either on Malaya or on Australia, whereas the results obtained by Miss Gibbs and by the Wollaston expedition in Dutch New Guinea go far to prove that New Guinea is really the focus of distribution for many types hitherto considered Polynesian or Australian. This applies to some extent also to Malayan types, of which the Papuan species appear to be not only older in type, but also very highly differentiated.

The endemic mountain types of New Guinea are found to have a wide distribution, and the low mountain forest flora shows marked affinity with that of the ridge formation of Kinabalu and the Philippines. In the forest region such interesting coniferous trees as *Araucaria Beccarii*, *Libocedrus arfakensis*—the genus being new to Dutch New Guinea—several species of Podocarpus and Phyllocladus, and a Dacrydium are commonly met with. Some good photographs of the Araucaria are reproduced. Six Rhododendrons, two being new species, and seven species of Vaccinium serve to indicate the northern affinities of the high mountain flora and its connection with that of Kinabalu.

During her short stay on the island Miss Gibbs collected 330 plants, 100 of which have proved to be new to science. Among genera not previously known from New Guinea may be cited Hibbertia, hitherto considered Australian and New Caledonian; Centrolepis, which connects the country with Borneo, the Philippines, and southern China on one hand, and with Australia and New Zealand on the other; and Patersonia, which, with the exception of southern China, shows a similar distribution, but was formerly considered to be a purely Australian genus.

Many of the new species are figured, but it is to be regretted that there are no proper references to the plates, and that the map and plan are so inadequate.

A. W. H.

HISTOLOGY OF VEGETABLE DRUGS.

Histology of Medicinal Plants. By Prof. W. Mansfield. Pp. xi+305. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 13*s.* 6*d.* net.

DURING the last few years a considerable amount of attention has been given to the histology of medicinal plants, or perhaps more correctly to the histology of organised vegetable drugs, and the importance of the subject is becoming more adequately recognised. Prof. Mansfield's work is the latest addition to the text-books on this section of vegetable histology, and on that account demands careful attention.

The author divides his work into three parts. Part i. deals with the simple and compound microscope, part ii. with tissues, cells, and cell-contents, and part iii. with the histology of roots, rhizomes, etc.

In part i. the usual details and illustrations of simple and compound microscopes are to be found, together with brief details on the mounting and preservation of slides. In part ii. various tissues, cells, and cell-contents are enumerated, and brief allusion is made to the differences between similar cells in certain drugs. This part is very fully illustrated with original drawings that have been carefully executed and that certainly do not err on the side of insufficient magnification. Part iii. deals in a similar way with the sections and powders of a very limited number of drugs.

There is nothing in the arrangement or general treatment of the details in these three parts that calls for special remark; it remains to be seen to what extent the author has been successful in attaining the object with which the book was written, and whether it can be recommended as a "practical scientific course . . . for the use of teachers and scholars in schools and colleges."

Now the essence of a practical course is instruction in the best methods of carrying out certain systematically arranged operations. It is much to be regretted that such instruction is not to be found in the book, and that there is no systematic course, progressing from simple to more difficult operations, outlined for the student. Meagre details occur here and there. The index affords little or no assistance, and it is to be doubted whether the object the author has in view will be attained until the work has been entirely remodelled. Should he take this task in hand, he would be well advised to submit many of his statements to searching revision, to correct inaccuracies, to introduce greater precision, and to make himself further acquainted with relevant literature. As an example, the statements on p. 85, lines 1 to 20, may be critically considered:

"The presence of cork enables one to distinguish Spanish from Russian licorice." It really only enables one to distinguish unpeeled from peeled root, and there are several varieties of each. "In *Canella alba* the periderm is replaced by stone cell-cork." This "cell-cork" is not cork at all, but phelloderm. "The cells . . . are of a typical cork shape, but the walls are lignified, unequally thickened. . . ." The walls of typical cork cells are very frequently lignified and often unequally thickened. "The inner or thicker walls are strongly porous." From the illustration it would appear that the outer walls are the thicker. "The cork periderm which fissures and scales off as the root increases in diameter." *Canella alba* bark is obtained from the stem and not from the root; the cork periderm does not scale off, but has to be loosened by beating.

It is to be regretted that in its present form the book cannot be recommended for either teacher or student. It possesses, however, some elements of a useful work, notably the carefully executed illustrations.

OUR BOOKSHELF.

Bedfordshire. By C. Gore Chambers. Pp. x+195. (Cambridge: At the University Press, 1917.) Price 1s. 6d. net.

THOUGH one of the smallest English counties and with nearly nine-tenths of its area lying in one river basin, Bedfordshire possesses considerable geographical interest. Travellers by the Midland Railway, which traverses its length from Luton to near Wellingborough, cross five geological belts and can recognise each in passing by characteristic features of contour, tree flora, agriculture, and building material. In the churches, manor houses, and "motte and baileys" there is a wealth of archæological interest. Moreover, it was in this county that James Wyatt and, later, Worthington Smith obtained their evidence of the existence of Palæolithic man in Britain.

This and much more finds adequate description in Mr. Gore Chambers's book. It follows the lines of the Cambridge County Geographies, and well maintains the standard of that series. The best sections are those dealing with ecclesiastical architecture, history, and antiquities, though, under the last-named, one looks in vain for any reference to the "lynches" of the northern escarpment of the Chilterns. Considering the varied flora and fauna, the natural history section is rather disappointing and needs revision. Under "Industries" a good historical account is given of the straw-hat manufacture.

Though the author did not live to see its publication, the book has been well edited and illustrated. "Father" for "fat-hen," as a local name for goosefoot, is the only misprint noticed. As a record it brings us down to 1914. Since then geographical change has been rapid. The gale of March, 1916, swept away the great walnut orchard noted on p. 55. The war is bringing changes far more profound: new industries into country places, steam cultivators into the grasslands, sawmills into the woods. A new era has begun, and it is all to the good that the book gives us a faithful picture of the county at the close of an era which has passed away. T. S. D.

The Pupil's Class-book of Geography: Scotland; Asia, with special reference to India. Each by Ed. J. S. Lay. Pp. 96 and pp. 128. (London: Macmillan and Co., Ltd., 1917.) Price 7d. and 8d. respectively.

IT is no easy matter to present geographical principles in a way that can readily be grasped by the average child of nine or ten years of age, but Mr. Lay has been fairly successful in his attempt, apart from a few lapses into the old-time memorising of place-names. The volumes are intended for study by the children themselves. With this end in view, they contain numerous questions, all of which can be answered from the text and the maps, and simple exercises in map- and diagram-drawing. Each book contains many diagrams and black-and-white maps, most of which are excellent, so that it is complete in itself and does not entail the use of an atlas. In the two volumes named above the author has been more successful in that dealing with Scotland. Asia is a more difficult task, and as half the volume is devoted to the Indian Empire the sense of proportion is lost—a serious defect in all geographical study. Climate is treated simply in accordance with the general plan: in Scotland the author has successfully evaded most pitfalls in his simplification, but in the case of Asia the treatment is less happy. The low price of the books is noteworthy. R. N. R. B.

The Historical Register of the University of Cambridge. Edited by Dr. J. R. Tanner. Pp. xii+1186. (Cambridge: At the University Press, 1917.) Price 12s. 6d. net.

THIS volume forms a supplement to the "Cambridge University Calendar," and provides a record of University offices, honours, and distinctions to the year 1910. Up to 1913, when it had grown to 1547 pages, the "Calendar" itself contained historical information; but in that year the Syndics of the Press decided to transfer the historical particulars to a separate "Historical Register," to be published less frequently. This rearrangement has made it possible to publish additional historical data, and among the added matter in the present volume may be mentioned lists of holders of University offices, professorships, and so on, from the earliest date of which there is any record; sections on the historical jurisdiction and procedure of the University courts, ceremonies, costume and discipline, as well as on the history of the Mathematical Tripos; and enlarged indexes. The Tripos lists in the old "Calendar," moreover, have been collated with the original sources, *aegrotats* and *honorary optimes* have also been included, and the footnotes have been rewritten.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ice Thistles.

IN NATURE for January 11, 1917, Dr. R. T. Gunther directed attention to the beautiful form assumed by the air bubbles which separate from water which is allowed to freeze in a small jar. I was able in the issue of February 15 last to describe some larger examples of the same phenomenon.

On December 26 last the ice on the Legs of Mutton Pond in Bushey Park and on the Cardinal's River, which flows through it, was very clear, and the bubbles, separated in the course of freezing, were very obviously arranged along lines of flow. In the pond they converged towards the outflow sill communicating with the river, and in the river they were in lines parallel to the banks. In one or two cases where the stem of a weed was frozen into the ice the course of the water as diverted on either side of it was made clear by curves of bubbles.

On the following day I managed to melt some of the ice over its own water, by the heat of the hand, in a bottle with the bottom cut off and a graduated tube inserted in the neck. Knowing the capacity of the bottle, and measuring the volume of water required to fill it when packed with ice, I got a fairly accurate measurement of the ice. The bottle was then put in a tin can with water, and the gas as it was liberated from the ice passed into the graduated tube.

From 104 c.c. of ice I obtained 1·86 c.c. of gas, of which 0·76 c.c. was absorbed by alkaline pyrogallate. A litre of this ice would therefore yield 7·18 c.c. of oxygen and 10·30 c.c. of nitrogen and argon, apart from any gases which might still be *dissolved* in the ice. The pond water under the ice yielded 31·2 parts of solid residue on evaporation and 2·35 parts of chlorine, and the melted ice (after settlement of suspended matter) 10·0 parts and 0·39 part respectively.

That the salts yielded by melting ice are no real part of it, but are derived from watery inclusions only, can be shown very beautifully by carrying out Dr. Gunther's "ice-thistle" experiment with water tinted with methylene-blue, or, better, potassium permanganate. A characteristic "thistle" with white silvery rays of air bubbles in a clear hyaline, and a central blue or crimson "egg" of solution much deeper in colour than the original solution, is obtained. This becomes smaller as freezing proceeds. Sometimes coloured veins are seen in the colourless ice, and some of the air bubbles are associated at their inner ends with coloured liquid. This experiment, as showing the separation of dissolved matters, both gases and solids, when a portion of a liquid freezes, seems to be worth noting, especially as it also illustrates the course of the freezing.

J. H. COSTE.

Teddington, January 11.

SCIENCE IN INDUSTRIAL RECONSTRUCTION.

WITHIN the past year or two, frequent reference has been made in these columns to measures of national reconstruction recommended by various committees. There is now a Ministry of Reconstruction, and its advisory committees are so many that we have almost lost count of them; whilst scarcely a week passes without a report appearing in which promising schemes of industrial organisation and development are projected. The material value of scientific research is usually given due recognition, at any rate on paper; and if we may take these signs as an earnest of things to come, they give us confidence in a progressive future based upon a just and intimate co-ordination of brain and hand.

Though manual and mental workers are often considered to belong to different classes, and an indefensible social distinction is usually made between them, no such separation can be recognised in scientific fields, where fine manipulation, and skill in the use of instruments, are frequently as valuable as fertility in idea and ingenuity in design. Industrial advance seems, indeed, to depend upon three main factors, in all of which brain and hand are related, though in different degrees. First there is the creative investigator whose work reveals new properties and relationships; then comes the inventor or industrial researcher who seeks to apply knowledge to useful ends; and when a practical process or machine has been devised, the artisan is needed to make it fulfil its technical purpose. Each of these three classes has an essential place in national polity; and the correlation of their interests and activities must be the chief aim of all schemes of reconstruction.

Several recent reports and manifestoes are concerned with the combination of these different groups. The Interim Report on Joint Standing Industrial Councils (Cd. 8606, price 1*d*. net), submitted to the Prime Minister by a sub-committee of the Reconstruction Committee, and referred to as the "Whitley" report, suggests the establishment of district and national councils which should deal, among other matters, with technical education and training and with industrial research and the full utilisation of its results. There has lately been established, under the presidency of Sir Wilfrid Stokes and the chairmanship of Mr. Ernest J. P. Benn, an Industrial Reconstruction Council to encourage the formation of national industrial councils in the several trades, and to offer guidance when necessary. Moreover, the draft constitution of the new Labour Party, which has just been submitted to the Nottingham Conference, has in the forefront of the party objects, "to secure for the producers by hand or by brain the full fruits of their industry"; and the secretary of the party, the Right Hon. Arthur Henderson, informs us that "the term 'producers by hand or by brain' would include scientific workers if they are prepared to accept our constitution and programme. The object in widening the basis of the party is to obtain the assistance of all who depend upon their own exertions for the means of livelihood."

Scientific workers are thus offered facilities for representation in Parliament if they are prepared to associate themselves with the Labour Party. Much can be said in favour of such co-operation,

for the influence of direct representatives of labour upon national affairs is likely to increase, and it would be unwise to stand altogether apart from the organisation which will control it. It was stated in the *British Medical Journal* a few weeks ago that the Labour candidates to be adopted for the next general election may include some members of the medical profession pledged to support the scheme for a State Medical Service. We suggest that the British Science Guild, which exists to promote the adoption of scientific methods in all national affairs, should consider at an early date whether steps should be taken to secure similar representation of scientific workers. The efficiency and progress of the modern State depend upon scientific knowledge. The Representation of the People Bill makes it possible to give that knowledge power in Parliament, and scientific workers should take active measures to attain that end, by association with other groups concerned with problems of national reconstruction.

What is to be the principal feature of the industrial reconstruction contemplated? Those who have thought much on the subject will probably reply in one word, "self-management." This implies, in the first instance, that each trade or group of trades has an aspect in which it is to be regarded as a corporate whole. We have been familiar with this kind of unity in the Church, the medical and legal professions, and, to a certain extent, in the combination which is known *par excellence* as "The Trade." The Bar comprises a great number of individuals each of whom has his private interests and competes with many others in the humbler or the higher ranks of the profession; but to the outer world the Bar is a corporate unity prepared to defend its privileges against all comers, and possessing its own machinery for self-management and even for discipline. A trade, on the other hand, consists of the several companies, firms, or individuals whose names are to be found in the trade directory, together with their employees, and, as a rule, there is no connecting link whatever between these scattered units, while in each firm the interests of capital, brains, and labour are regarded as distinct. The war has introduced many new phases. We have seen whole industries placed under Government control. Each firm has retained its integrity, but it has been required to work in co-operation with other firms, so as to secure, on the whole, the maximum output of the goods required at the time to meet the exigencies of war. When this demand ceases Government control will also cease, but great efforts will be made to secure that the advantages of a central guidance of each industry shall not be lost.

This guidance must come from the industry itself, and from the industry as a whole. Labour and capital are to meet at the same board on equal terms. The Whitley report recommends that these councils shall be "composed of representatives of employers and employed, regard being paid to the various sections of the industry and the various classes of labour engaged." The various classes of labour must include those who work mainly with their brains, as well as those who work mainly with their hands. It is true that the Food Controller, in specifying voluntary rations, makes a broad distinction between these two classes, and does not admit that hard thinking produces as much metabolism as an expenditure of energy which can be more readily measured in foot-pounds, but the new Labour Party, in its draft constitution, makes no such distinction. The modern psychologist recognises not only that the brain controls the hand, but also that the use of the hand develops the brain, and that sometimes in an unexpected direction, as when the power of speech is developed by manual training. The Labour Party recognises the unity between hand and brain, and is prepared to admit the brain-worker to all the advantages which it hopes to derive from reorganised industry.

The suggested industrial councils should each form an Upper Chamber in the interest of its industry. They should consist of representatives, not of particular firms or individuals, but of associations of employers and employed wherever such exist, and care must be taken to secure the fair representation of all such associations. At the meetings of the councils the representatives of labour will unite with employers in the consideration of the most difficult problems which the trade has to face. If it be true that the industrial unrest of the past has been largely due to a feeling on the part of labour that it has been kept in ignorance of trade politics, the remedy is here provided, for labour will be given seats in the industrial House of Lords. The national industrial councils will be in touch with district councils, and these with works committees. Through this machinery the industrial councils will exert their influence in particular works.

The Whitley report indicates under eleven heads some of the questions with which the industrial councils should deal. Reference may here be made to the better utilisation of the knowledge and experience of the workpeople, securing to them more responsibility for the conditions under which their work is carried on, technical education and training, industrial research and the utilisation of its results and of inventions and improvements designed by workpeople. Besides these and the other points for consideration indicated in the report, a number of very important problems will arise immediately on the cessation of the war, and these make it imperative that the councils should be formed at once, or the opportunity of organising British industry on a basis on which it can meet foreign competition without a handicap may be postponed indefinitely. The council will be the parliament of the trade. At its meetings all questions affecting the trade will be discussed, and the results of the discussion will be public to the whole trade, so that the smallest manufacturers

will have the advantage of the knowledge and experience of the largest, while the latter will benefit by the combined knowledge, experience, and advice of all the rest of the trade. In many cases new sources of raw materials will have to be found and new methods of finance devised. The problem of the best way to secure adequate representation of British industry in foreign markets will have to be solved, and the best way of utilising the new part-time continuation schools considered. In all these questions labour will be consulted, and the employed will take an equal part with employers. The watchword of reorganisation is "Unity of industrial interest."

The general principles voiced by the Whitley report have received recognition on all hands, but some organising force is necessary to give them practical effect. This is the purpose of the Industrial Reconstruction Council. It is desirable that some obviously disinterested body should take the first step towards establishing a council in a particular trade. The I.R.C. is prepared to send representatives to a meeting, large or small, of any association of employers or employed in order fully to explain the mode of formation and functions of an industrial council. The Ministry of Reconstruction can be approached at a later stage when the scheme has been drafted by the industry. An industrial council consisting of equal numbers of employers and employed has already been formed for the pottery industry. This council will establish committees for dealing with special branches, and may co-opt outside experts upon them. Among its special duties will be that of making the manufacture of pottery as hygienic as possible.

The aims of the Labour Party, of course, go far beyond the organisation of particular trades. The chief appears to be to form the dominant party in the House of Commons. Unfortunately, the promoters look forward to a perpetuation of the system of party government; but if all the workers by brain, as well as by hand, combine into one party for the government of the State on democratic lines, party government will practically cease, because one party is equivalent to no party. Scientific men will certainly not be disposed to support any system of party politics, and they would be more likely to take part in the new programme if it were made clear that the Labour Party signified a federation or organisation in which brain and hand were united for common welfare rather than the narrow interests of one particular section of the country's life. The question has been asked, "Will the brain-worker secure adequate representation in the councils of the Labour Party?" Provided that the community of interest between hand and brain is fully recognised, the hand may be trusted to make use of the brain, and the brain will not suffer from failure to take part in the work of the world. May we not hope that government by dialectics will belong to History?

THE FERTILISER SITUATION IN THE UNITED STATES.

FOR some time after the war had opened, and in particular when the unrestricted submarine campaign began to assume important dimensions, the United States found that its supplies of the three most important fertilisers were seriously compromised: instead of being, as many had imagined, wholly a producing country, it was found to be dependent on other countries for these vital raw materials. Chile supplied nitrate of soda, the most potent nitrogenous fertiliser; Spain sent the pyrites necessary for the manufacture of sulphuric acid, which in turn forms the basis of the superphosphate and sulphate of ammonia industries; while Germany sent potassium salts, without which many mixed fertilisers are incomplete. With characteristic promptitude the situation was carefully reviewed, and a statement has been issued by the Smithsonian Institution[1] showing in as much detail as is judicious how the United States now stands in the matter.

The situation in regard to phosphatic fertilisers is rather peculiar. The United States claims to possess within its borders the largest known deposits of rock phosphate in the world. The annual output is three million tons. Most of this (about 75 per cent.) comes from Florida, where there are three types of deposits: rock phosphate, pebble phosphate, and soft phosphate, all superficial horizontal beds of solid rock or loose pebbles representing a residue of phosphate left after the associated rock had been dissolved and washed away. These deposits can be worked by large open pits, and being situated near the coast, the material can be readily transported to other parts of the country or to Europe.

Other deposits occur in South Carolina, Tennessee, Kentucky, and Arkansas, but by reason of their smaller output and less favourable situation for transport they are less important than those in Florida.

In course of time these supplies must become exhausted, and rather gloomy pictures have been drawn of the days when lack of phosphates would jeopardise, and finally terminate, man's existence on this globe. Great interest, therefore, attaches to the discovery made in 1906, and since confirmed, that a belt of country stretching from Salt Lake City, in Utah, to Helena, in Montana, contains a number of beds of phosphatic rock. The amount is said to be larger than in any other known deposits.

So far, therefore, as the rock phosphate is concerned, the United States is in a very strong position. But, unfortunately, rock phosphate alone is not wholly suitable as a fertiliser. In some instances, especially where the soil is rather acid, it acts very well, and Dr. Cyril Hopkins and other well-known agricultural experimenters have studied these cases in some detail, thus accumulating very valuable information.

In many other cases, however, better results

[1] "The Mineral Industries of the United States." By J. E. Pogue Smithsonian Institution Bulletin No. 102, 1917.

are obtained when the phosphates are treated with sulphuric acid. But this requires pyrites from Spain, which is no longer easy to get, and in any case the resulting sulphuric acid is also needed for making explosives. Other sources of sulphur are, therefore, being exploited, in particular the pyrites and the pyrrhotic deposits of the Eastern States and the sulphur deposits of Louisiana and Texas.

The nitrogen problem is extremely urgent. Chilean nitrates are largely used for making explosives, and are practically unobtainable for agricultural purposes. Prior to the war the largest source of fertiliser nitrogen in the United States had been the various organic products, such as tankage, fish scrap, and cotton-seed meal, produced in the country. With the coming of the war, however, other demands have been put upon most of these, and their prices have risen; thus cotton-seed meal is now used as animal food.

Coal is a satisfactory source of nitrogen, one ton of American coal containing on an average 20 lb. of nitrogen. The proportion actually recovered, however, is only small, corresponding in 1913 with 3 per cent. of the total quantity of coal mined, but a higher recovery is said to be obtained to-day. In 1913 about 12 per cent. of the coal (or 69,000,000 tons) was made into coke, but three-quarters of this was done in the old bee-hive oven, and only a quarter in the more modern ovens from which recovery of the nitrogen is possible. This proportion, however, is steadily increasing.

All these methods are essentially transitory; they come to an end in that indefinite time when coal and nitrate of soda are both exhausted. The permanent, never-failing supply is the atmosphere. Already calcium nitrate, cyanamide, and ammonia are produced synthetically, but of these only cyanamide is as yet made in North America, and that only on the Canadian side of Niagara. The need, however, is fully recognised, and the work is being vigorously pushed forward. The sum of twenty million dollars was appropriated in 1916 for the construction of the plant, and although the scheme is not yet in working order, we may be sure that it will materialise. The peculiar and profound importance of these synthetic processes as the central feature of the war is fully recognised, and, as the author of the Bulletin justly remarks: "It is significant that war was declared directly after the successful development of the Haber and cyanamide processes in Germany."

The dependence of the civilised world on Stassfurt for its necessary potash was accepted as a natural and fundamental fact prior to the war, and very little was done to obviate it. Potassium is extremely common; only seven other elements are more abundant, and it is calculated that there is more potash in the earth's crust than water. But, unfortunately, workable deposits are rare, and only the one at Stassfurt is actually worked to any notable extent. For some time before the war the United States Government recognised the drawbacks of the position, and caused a systematic search to be made for potash within its own borders. A limited amount of potash can be obtained from the wood-ashes of the lumber industry in Michigan and Wisconsin. Another source is the mineral alunite, a potassium aluminium sulphate occurring in moderate-sized deposits in Utah. Another, again, is kelp produced from the giant seaweed of the Pacific coast from Lower California to Alaska. A more important source is the flue-dust obtained from Portland cement works and from blast-furnaces. Still more important from the point of view of immediate production are the alkali lakes of the West, which at present yield most of the American supply: Jesse Lake, in western Nebraska, supposed to derive its potash from the forests burnt on the adjacent plains; Searles Lake, in California, reputed to contain great quantities of potash, though there are so many other salts as well that the extraction is by no means simple; Owen's Lake, also in California, several lakes in Oregon and elsewhere. In addition, there are salt beds in Texas, Oklahoma, and other places where some of the underlying strata were formed in arid climates.

There are still other possibilities which have not yet come to anything, though they are not without promise for the future: felspar, which occurs in scattered and rather small deposits; leucite, forming a conspicuous component in a rock mass of considerable size in Wyoming; sericite, which forms extensive beds in Georgia; and greensand, found widespread in the Atlantic coastal plain, especially in New Jersey. All these are open to exploitation.

But what will be the future of these new fertiliser industries, assuming they mature? Will they disappear after the war, choked by the competition of German products, or will they be kept alive by artificial support? This is a political question scarcely less important than the chemical and engineering problems involved, and one which we may be sure will receive serious and systematic consideration.

E. J. RUSSELL.

WHAT DETERMINES STATURE?[1]

DR. C. B. DAVENPORT has collected data in regard to human stature, and analysed them by modern methods of studying heredity. Some of the data refer to 2354 children of parents whose height is recorded, but the precision of this recording was very unequal. The other data refer to the inheritance of stature in families, and these, while less numerous, are more uniformly precise.

For the class of people dealt with, it appears that nutrition is not of much importance in determining stature. It is improbable that insufficient or improper food counts for much in determining eventual height; "temporary starvation has little or no effect on the end result. So, likewise,

[1] Bulletin No. 18, "Inheritance of Stature." Pp. 313-89+33 tables and 19 figs. (Eugenics Record Office, Cold Spring Harbour, N.Y., 1917.) Price 40 cents.

overfeeding, however much it may affect weight, has probably little effect on adult stature, though it may hasten growth and thus enable a man to reach precociously his predestined stature." Of great importance, however, are the internal secretions of the gonads, the thyroid, the pituitary body, and other endocrine glands. The degree of activity exhibited by these glands is a variable and heritable constitutional character, but it is also modifiable by severe diseases and accidental extrinsic influences. In two ways, therefore, stature is affected by the degree of activity of the ductless glands, and "experience points strongly to the conclusion that internal constitutional factors are more important than the ordinary environmental differences."

The following are among the most important conclusions which Dr. Davenport has reached. One of the factors determining variation in stature is variation in the age of the onset of puberty. Parents deviating from the mean in the same direction have on the average less variable offspring than those of one short and one tall parent. The offspring of two tall parents are less variable in stature than those of two short parents. When the stature of both parents is very much above or below the average, the children tend to repeat it, especially in the direction of tallness. When the parents are much below the average the offspring regress towards mediocrity, but there is no (or little) filial regression when the parents are much above the average. It seems that parents of all statures are somewhat heterozygous (or "impure") as regards their peculiarity, but there is evidence in favour of the theory that in tall parents the gametes are more nearly homogeneous (in lacking most of the shortening factors) than are those of "short" parents. Shortness seems to be due to certain positive factors which inhibit the growth of various parts. It appears that "growth-as-a-whole" factors are present, but there is a large degree of independence in the variability of the four segments of stature (head and neck, torso, thigh, and lower leg); and this makes impossible any simple "Mendelian" laws of the inheritance of stature as a whole.

There is evidence that peculiarities in the separate segments of stature are independently heritable, and the combinations of types with different proportions (though similar in total stature) may give curious, but readily intelligible, results. The proportional shortness of any segment depends on more than one shortening factor—just how many cannot be said. It is probable that in all forms of dwarfing there are multiple dominant inhibiting factors. In the case of gigantism in both parents all the children are tall; "this indicates that the factors for tallness are mostly recessive—probably due to the absence of inhibitions to prolonged growth." "Persons of similar stature tend to marry each other; and extremes are more particular in this respect than those of medium statures."

These are the most important conclusions of this interesting piece of work, but it is evident that "the classic topic of the heredity of human stature" must be subjected to further analysis with even larger bodies of data. In admitting the provisional character of his investigation, Dr. Davenport says: "If the work has done nothing more than prove, what might have been anticipated, that the apparent blending inheritance of stature is due merely to the presence of multiple factors, it may be justified."

NOTES.

IN various parts of the country camouflaged houses and hangars and vessels are to be seen by those who have eyes to see, and it was stated officially on January 14 that the Admiralty had tested many methods of disguising mercantile shipping. One of these methods is to paint the ship with various quaint combinations of different colours. But this does not appear to have proved much of a success, though we know in Nature of conspicuously patterned creatures, such as the hoopoe, which are, in certain situations and poses, endowed with what amounts to a garment of invisibility. Another method, well illustrated by a model in the British Museum (Natural History), depends on what is sometimes called Thayer's law, the announcement of which was first made in NATURE of April 24, 1902, by Prof. E. B. Poulton. A further illustrated description of the principle was given in an article in our issue of October 27, 1910. Mr. Abbott H. Thayer, an American artist, was one of the first to recognise that a high degree of invisibility is conferred on certain birds by the simple adaptation of being dark above and whitish below. He took two wooden decoy ducks, and placed them against a sandbank. One was coloured like the sand, or coated with sand; the other was coloured on its upper parts darker than the surrounding sand, and graded below to pure white. At a short distance the first was still clearly visible, but the second was quite lost against its background. The first bird was revealed by the dark shadow below it; the second was made invisible because the light lower parts were neutralised by the shadow, while the dark upper parts were toned down by the strong direct light. The result is technically described as obliteration by counter-shading. Some modification of this experiment has been tried on ships by differential painting, but this device has not proved so successful as had been hoped by those who knew how obliterative it was in some birds and fishes. On some other quite different line, it is said, the Admiralty has discovered a system of camouflage which will go far to baffle the eyes of submarines.

IT would appear from some recent statements by the Ministry of Munitions that the production of mineral oil from native sources is engaging the close attention of the Department of Mineral Oil Production. It may be inferred that boring for petroleum in Great Britain has not yet been attended with any success, and so far the opinions of the large body of British geologists who were opposed to these boring operations appear to have been justified. Oil has, of course, continued to be produced in Scotland by the distillation of the so-called oil shales of the Carboniferous Measures, and it appears that the output of this oil is being pressed to the utmost. It has been known for many years that the Kimmeridge shales of Liassic age in the south of England are in places quite rich in oil, and a succession of companies has attempted in the past to create there a shale-oil industry on the same lines as

in Scotland; all these attempts proved, however, to be commercial failures, and it would seem that no better fate has attended the more recent efforts of the Ministry of Munitions. The latter has accordingly turned its attention to the production of oil by the low-temperature distillation of coal by practically the same process as that patented by Dr. James Young in 1850, a process that was worked on a commercial scale for a good many years until it was displaced by the far cheaper production of natural petroleum in the United States. To-day, however, when commercial results are in a sense less important than technical ones, this process may well be revived in this country, and it would seem that this is being done, coals that are especially suited to it, such as cannel coal, being selected for the purpose. No doubt experiments are being tried in many other directions, but there are obvious reasons why the nature of these, or the results obtained by them, should not be made public at present.

WITH the continuance of the war the production of zinc from ores mined in the Empire has undergone a satisfactory development. For a time much of the ore could not be absorbed in the reduction works until the necessary plant had been erected and was in running order, the labour mobilised and trained, and the transport organised. During this period some of the Australian Broken Hill concentrates were shipped to the United States of America and smelted there. Great Britain raised her smelting capacity, but rather slowly. Canada has made a notable contribution of metallic zinc in the last two years, and is now producing substantial amounts. Some of this is obtained by the electrolytic process. Considerable sources of electric power are available in Tasmania, and it is not surprising to learn that Broken Hill concentrates are shipped for treatment there. Satisfactory results have recently been reported from the electrolytic plant erected at Risden. This plant has a daily capacity of fifteen tons, which, it is said, can be increased tenfold, corresponding to a potential production of more than 50,000 tons per annum. The power is obtained from the States Great Bear hydroelectric installation. That electrolytic zinc is now being produced in considerable quantities in various parts of the world is likely to prove of much importance to industry.

AN important scheme for the reorganisation of the Board of Trade is summarised in a memorandum (Cd. 8912) issued on January 17. The memorandum embodies the results of consultation with an informal committee consisting of Sir Clarendon Hyde, Sir Algernon Firth, Mr. Mackinder, M.P., and Mr. C. T. Needham, M.P., and its recommendations are supplementary to the action already taken in the formation of the Joint Department of Overseas Trade, recently set up by the Board of Trade and the Foreign Office. It is proposed that the work of the Board of Trade should be organised in two main divisions: (i) the Department of Commerce and Industry, and (ii) the Department of Public Services Administration. The Department of Commerce and Industry will comprise sections dealing with (*a*) commercial relations and treaties; (*b*) Overseas trade; (*c*) home industries and manufactures; (*d*) industrial property (including the Patent Office); (*e*) industrial power and transport; (*f*) statistics; and (*g*) general economics. There will be a strong Advisory Council attached to this department, and it is proposed to constitute representative trade committees for each important group of trades. Certain changes and rearrangements will apply to the work of the branches of the Board of Trade falling within the Department of Public Services Administration. The work will, as before, involve the administration of a number of statutes, such as the Railway Regulation Acts, Merchant Shipping Acts, General Harbour Acts, Electric Lighting Acts, Weights and Measures Acts, Companies Acts, and Bankruptcy Acts. The department will also deal generally with the services concerned (railways, shipping, electric lighting, etc.). The two joint permanent secretaries are Sir Llewellyn Smith, K.C.B., and Sir W. F. Marwood, K.C.B.

IN an article on modern methods for the storage of coal in *Engineering* for January 18, Mr. G. F. Zimmer states that storing coal under water is probably the most expensive method, but undoubtedly the most economical in the long run. About the year 1905 the first experiments made in this country on this method proved to be perfectly successful, as the coal thus stored suffered no deterioration. There was a prevailing idea at the time that only sea-water would preserve coal thus, but it was found afterwards that the coal would keep equally as well in fresh-water. Underwater storage prevents loss of heating value, and is not accompanied by deterioration in physical properties, such as slacking. The water retained by the coal upon removal is substantially only that held by adhesion or capillarity. The first large plant of this kind was installed at Chicago, where 14,000 tons of coal are stored under water. The largest installation has recently been erected by the Duquesne Light Company at Pittsburg, and consists of a pit 800 ft. long, 150 ft. wide, and 25 ft. 6 in. deep, with the sides sloping at 45°. The capacity is 100,000 tons of coal. It is interesting to note that the coal recovered from the battleship *Maine*, which had been submerged for fourteen years, showed on analysis a heating value (a moisture, ash, and sulphur-free basis) of 8588 calories. It is believed that this was coal from the New River District, West Virginia, and if this be the case the deterioration in fourteen years was about 160 calories, or 1·9 per cent.

SIR ANTHONY A. BOWLBY has been appointed Hunterian orator of the Royal College of Surgeons of England for the year 1919.

PROF. V. GIUFFRIDA-RUGGERI, professor of anthropology in the University of Naples, has been elected an honorary member of the Royal Anthropological Institute of Great Britain and Ireland.

WE learn with much regret that Miss Ethel Sargant, F.L.S., hon. fellow of Girton College, and president of the Section of Botany of the British Association for the Birmingham meeting, 1913, died at Sidmouth on January 16, at fifty-four years of age.

THE annual general meeting of the Institute of Metals will be held on Wednesday, March 13, and Thursday, March 14. The presidential address will be delivered and several papers read and discussed on March 13, whilst further papers, including the fourth corrosion report, will be read on the following day.

AT the annual general meeting of the Royal Meteorological Society held on January 16 the Symons Memorial medal, which is awarded biennially for distinguished work in connection with meteorological science, was presented to Dr. H. R. Mill, director of the British Rainfall Organisation. The council for 1918 was duly elected, with Sir Napier Shaw as the new president.

MR. J. S. SELLON, whose death in London on January 18, at the age of eighty-one, we regret to record, was the fifth son of Capt. W. B. Sellon, R.N.

At an early age Mr. Sellon joined the well-known business house of Messrs. Johnson, Matthey, and Co., assayers and refiners to the Bank of England and Royal Mint, metallurgists, etc., founded by his uncle, Percival Norton Johnson, in 1822. He played a prominent part in the researches and industrial developments connected with the platinum and other groups of rarer metals, with which the name of his firm is closely associated; indeed, the now numerous and important commercial applications of platinum and its allied metals may be said to be chiefly due to the initiative and efforts of himself and his co-workers, George and Edward Matthey. During the concluding quarter of last century he also took an active share, both in the fields of technical discovery and industrial development, in the then new sphere of electrical engineering, and was associated with Faure, Brush, Swan, Lane-Fox, Volckmar, and others in their early work on electric lighting and storage.

We regret to note that the death of Mr. Frederic Eliot Duckham is recorded in *Engineering* for January 18. Mr. Duckham was born at Falmouth in 1841, and his early engineering experience was obtained in the construction of docks. He was appointed engineer-in-chief of the Millwall Dock in 1868, and steadily advanced in the service of the dock authorities, becoming general manager in 1899. He held the dual appointment until his retirement in 1905, when he was elected a director, a position he held until the property was taken over by the Port of London Authority. His name is best known on account of his successful inventions, of which the most important was his pneumatic grain elevator, which saved the Millwall Company 8000*l.* per annum. Mr. Duckham became an associate of the Institution of Civil Engineers in 1875, and was elected a full member in 1878; he was awarded the Telford gold medal and two premiums for papers read before the institution.

At the meeting of the Illuminating Engineering Society on January 15 an address was delivered by Mr. L. Gaster on "Ten Years of Illuminating Engineering: its Lessons and Future Prospects." Mr. Gaster recalled that it was just ten years since the proposal to form an Illuminating Engineering Society was made. A feature of its work had been the opportunities afforded for co-operation with other societies; for example, in dealing with such matters as school, library, and street lighting. While the war had naturally restricted their activities in some fields, in others they had found new channels of usefulness; he might mention their special work on the illuminating value of star-shells and parachute lights, and researches on the brightness of radium paint for gun-sights, to which allusion had been made in the presidential address. It was desirable that better facilities should be provided for co-operation between scientific and technical societies and the State. Much useful information might be obtained in the present exceptional circumstances; fuller data were needed on the effect of inadequate lighting in causing street accidents and the influence of various conditions of lighting in Government factories on the quality and output of work. In order to illustrate how such data might be obtained, several tables were presented relating to accidents in streets and factories enabling information to be acquired on a uniform and systematic plan so as to trace the relation between such accidents and inadequate illumination.

Weather conditions in 1917 were at many times exceptional, although the mean results for the several elements for the whole year were not very different from the normal. At Greenwich the mean temperature was 49°, which is 0·5° deficient in comparison with the average for previous years. The highest monthly mean temperature was 63·3° in June and July. The warmest day temperatures occurred in June, when the mean was 74·9°, but the warmest nights were in August with a mean minimum reading of 54·3°. The lowest monthly mean temperature was 35·3° in January and February. In April the deficiency of the mean temperature was 4·5°, whilst in May the excess was 4·5°. There were 127 days with ground frost during the year; the greatest number in any month was twenty-seven in December. Rainfall at the national observatory totalled to 25·3 in., which is 1·5 in. more than the average, and 4·5 in. less than the total in 1916. There was an excess of rain in the spring and summer months, and a deficiency in the autumn and winter. The heaviest monthly fall was 4·3 in. in August, and in July the fall was 4·2 in. February was the driest month with 0·8 in. There was precipitation on 163 days, which is thirty days fewer than in 1916. August had twenty-three days with rain, whilst June had only seven, and December eight. Snow was unusually frequent, falling at Greenwich on fifty-one days. January had as many as sixteen days with snow, and the opening month of 1918 bids fair almost to equal it. Duration of bright sunshine for the year amounted to 4·14 hours per day, which is in excess of the normal, and is nearly forty minutes per day greater than in 1916. June was the brightest month, with an average of 7·5 hours per day of sunshine. January was the least sunny, with a daily average of 0·5 hour of sunshine.

In *Science Progress* for January Mr. J. Reid Moir discusses pre-Palæolithic man in England. He points out that in East Anglia the greatest facilities exist for recovering evidence of this period. He bases the existence of pre-Palæolithic man on the following considerations:—"(1) The discovery in various parts of England of different kinds of flint implements in deposits which are of greater antiquity than those containing the earliest palæoliths. (2) The discovery at Piltdown, in Sussex, of the remains of a very primitive type of human being in intimate association with certain definite Pliocene mammalian forms, and the earliest kind of flint-implements known to science." He adds that "the Neolithic and Palæolithic stages in this country are fairly well known, but the vast pre-Palæolithic periods await examination. These periods are fully represented in England, and the flint implements, etc., contained in the deposits laid down during these epochs must be collected and investigated."

It is an indication of improvement in the political situation of Mexico that, according to the *Mexican Review*, vol. ii., No. 2, the exploration of the famous ruins of San Juan Teotihuacan, which had been suspended during the revolutionary period, has now been resumed under the direction of the Secretary of Fomento, and it is believed that some very interesting and important discoveries will be made. Prescott describes these ruins, with the possible exception of Cholula, as the most ancient remains on Mexican soil. They were found, it is said, by the Aztecs on their arrival in the country, when Teotihuacan, "the habitation of the gods," now a petty village, was a flourishing city, the rival of Tula, the great Toltec capital. The two principal pyramids were dedicated to Tonatiuh, the sun, and Mezlli, the moon. The former, which has recently been restored, is 652 ft. in length at the base, and 182 ft. in height, thus rivalling some of the kindred monuments in Egypt. There is at present no building on the summit, but the photograph accompanying the article shows what seem to be processional roads used for some ceremonial purpose.

WE have received copies of the official tide-tables of the Pacific and Eastern Coasts of Canada for 1918, issued free by the Dominion Department of Naval Service. The eastern tables are based on records varying from seven to twenty years. The Pacific tables are naturally based on shorter series of records, but it is claimed that in accuracy they are superior to the tide-tables for any ports in the Pacific Ocean in America, Asia, or Australia. Next to these Canadian ports is San Francisco, which is based on the longest record at any harbour on the Pacific coast of the United States.

A STUDY of the nationalities of Hungary is of great importance in relation to the Slav claims on that country. In the December (1917) number of the *Geographical Review* (vol. iv., No. 6) Mr. B. C. Wallis has a detailed paper on the subject, accompanied by several small but admirably clear maps, two of which deal with density of population and distribution of nationalities respectively. Mr. Wallis's analysis of the population gives little support to the claim of the northern Slavs, Slovaks, Czechs, and Poles, for union with the southern Slavs by a corridor of territory along the border-lands between Austria and Hungary. The population of the Austrian part of that corridor is entirely German, and of the Hungarian part chiefly German. The Jugo-Slav claims to the Bačka have more foundation, but cannot be admitted as a whole on a basis of nationality.

. K. DAVIS contributes to the *Geographical Journal* for January (vol. li., No. 1) a short account of the *Aurora* Relief Expedition to the Ross Sea in December, 1916, and January, 1917. The *Aurora* left Port Chalmers with Sir Ernest Shackleton on board on December 20, 1916. After entering the Ross Sea Capt. Davis skilfully avoided heavy ice by keeping to the west, and did not enter the pack until he reached 70° 20′ S., 175° 20′ E. Then followed five difficult days spent in traversing a belt of pack, 104 miles wide, after which the *Aurora* emerged into the open sea, and reached McMurdo Sound. Off Cape Barne fast ice extended across the sound on January 10. After the seven survivors of the expedition had been embarked, the ship crossed to Butter Point, where Sir Ernest Shackleton searched the coast fruitlessly for the two missing men. A further search at Cape Barne and Glacier Tongue resulted in no clue, and it was decided to return to New Zealand. Off Cape Adare heavy ice was encountered, to avoid which Capt. Davis returned southward and bore northward further to the east, thus passing through the pack and out of the Ross Sea. The *Aurora* returned to Wellington on February 9, 1917, and in June left New Zealand, homeward bound *viâ* Cape Horn. We regret to hear that no definite news has been received of her since her departure from New Zealand, and that there is little hope of her arriving in port. On her homeward voyage the *Aurora* was in command of Capt. Reeves.

THE thirty-first annual report of the Marine Biological Station at Port Erin shows that twenty-one workers have occupied tables in the laboratory during the past year, twelve of these being students who attended the course of instruction during the Easter vacation. The usual operations were carried on in the plaice and the lobster hatcheries. Nineteen plaice, hatched and reared during the season of 1914, and afterwards kept in the pond, spawned this season. These fish had attained an average length of 10½ in. It was noticed that their eggs were smaller than the average egg of the plaice, the proportions being as 5 to 6·5, but otherwise were normal. Appended to the report is an interesting address (30 pp.) by Prof. Herdman on "Sir John Murray, the Pioneer of Modern Oceanography."

THE annual report of the Scottish Marine Biological Association for 1916 gives an account of the work of the marine laboratory at Millport. During the year nine workers, in addition to students attending courses of instruction, occupied tables in the laboratory, and the report contains notes on some of the results of their investigations, especially noteworthy being those of Messrs. J. H. Paul and J. S. Sharpe on the deposition of lime salts in the integument of decapod crustacea, and the observations of Dr. J. F. Gemmill on the development of certain starfishes and sea anemones. The eggs of three species of anemones were obtained in the aquarium, and the larvæ reared either to the stage of fixation or to the final form in separate hatching vessels under aeration. In *Adamsia palliata* and *Actinoloba dianthus* it was found that the formation of the endoderm takes place by invagination, and that in the formation of the blastula of Tealia a much-folded stage occurs which does not appear to have been noticed previously.

THE courtship and subsequent events in the life-history of the moorhen during the breeding season are briefly and skilfully summarised by Miss Frances Pitt in *British Birds* for January. The aggressiveness of this species in asserting its territorial rights is well known. After observations extending over three seasons, Miss Pitt is confident that these rights are challenged, for the most part, by the young of the previous year. This is what one would have expected. Incubation appears to begin long before the clutch is complete, and during the whole period of sitting new material is constantly added to the nest, so that it has reached a considerable size by the time the last chick has hatched. The young remain for some days in the nest, where they are assiduously fed on insects by both parents. But they will drop out of the nest into the water on the slightest alarm; this leads to considerable and hitherto unsuspected mortality, for frequently the nursery is placed on the bough of a tree at some distance above the water. In such cases the nestlings are unable to return when danger is past, and speedily die of starvation. A second, supplementary, nest appears generally to be built for the use of the young, presumably after they have left the first to acquire the art of feeding themselves. Finally, some interesting observations are made on the loss of the brilliant coloration of the head which characterises the nestling of this species, in common with that of its ally, the coot.

WE have received vol. xiv., part ii., of the Proceedings of the Birmingham Natural History and Philosophical Society, which contains several interesting papers, and in particular "A Survey of the Flora of East Worcestershire," by Mr. John Humphreys, to which we would direct the attention of botanists and geologists in particular. A great number of different geological formations are represented in this district from Archæan rocks to the Lias, with several limestones of different ages, and the effect on the flora is very marked. This is especially noticeable on the calcareous rocks of the Lias, where a great collection of new forms crop up. At Droitwich, Hartlebury Common, and the Salwarpe valley an interesting set of maritime plants occurs, and though the theory that in late Pleistocene times the sea penetrated to the present 100-ft. level is not now generally accepted, the presence of such plants is difficult to explain. Birds and insects afford similar evidence, and certainly lend support to the view that estuarine conditions prevailed in the Severn Valley in recent geological times. Hartlebury

Common is a remarkable spot for the botanist, and is still fortunately an untouched and unspoilt piece of country. For this and other interesting places careful lists of the more uncommon plants are given.

CAPT. T. S. MASTERSON read a paper on "The Petroleum Industry of Rumania" before the meeting of the Institution of Petroleum Technologists on January 15, in which he presented a very useful summary of the position of this industry up to the time of the entry of Rumania into the European war. He gives a brief account of the geography and geology of the Rumanian oilfields, and discusses at some length the methods of exploitation employed. He shows why the American method of drilling has proved a comparative failure, whilst the Canadian method has proved very successful, and is preferred by most Rumanian operators. The percussive water-flush method has not fared much better than the American method, but, on the other hand, the modern rotary system has been highly successful in the loose sandy marls met with in certain areas. The author concludes that no one system can be advocated for general use in Rumania, but that in each case the system best adapted to the conditions must be selected, wherever these conditions are known; in unexplored fields he recommends the use of the percussion system. He states that Rumania possessed sixty-one refineries with a total capacity of 4½ million tons, whereas the highest output of crude oil obtained in any year was only 1·9 millions. He further directs attention to the fact that practically the whole of the plant for these refineries was supplied from Germany, together with most of the raw materials employed in the construction of drilling rigs. In November, 1916, when the retreat of the Rumanian Army became inevitable, the wells and refineries were destroyed as completely as possible, and the paper concludes with an expression of the hope that when the times comes for reconstruction Great Britain will take steps to see that she shall be in the position to furnish the requisite materials.

A NEW type of differential dilatometer for thermal investigations on steels is described in the September-October *Revue de Métallurgie*. The author, M. Pierre Chevenard, claims that the instrument is well adapted for use in a steel works laboratory on account of trustworthiness and simplicity of design. Only small quantities of metal are necessary; the instrument is easy to set up, and the readings are unaffected by vibrations. An instrument of the type he describes has been used for some time for routine tests in a large steel works in France. It provides a useful complement to the chemical and micrographic examination of certain steels and their constituents, such as cementite, etc. Finally, it has proved of value in the qualitative examination of slight modifications in the dilatability of metals due to thermal or mechanical influences. The author remarks, in conclusion, that the examination of these and certain other phenomena rightly comes within the scope of precise metrology.

THE following volumes are announced for early appearance in the "Collection Horizon" of Messrs. Masson et Cie., Paris :—"Les premières heures du Blessé de Guerre," P. Bertein and A. Nimier; "L'Évolution de la Plaie de Guerre," Prof. A. Policard; "Commotions et Emotions de Guerre," Prof. A. Léri and Th. Beck; "Traitement des Psychonévroses de Guerre," G. Roussy, J. Boisseau, and M. d'Œlsnitz; "Blessures du Crâne," T. de Martel (revised edition); "Blessures du Cerveau," C. Chatelin (revised edition); "Prothèse fonctionnelle en Chirurgie de Guerre," Ducroquet; and "Blessures de la Moelle et de la Queue de Cheval," Prof. G. Roussy and J. Lhermitte.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET.—The following continuation of the ephemeris of Encke's comet is from Mr. Viljev's elements, and is for Greenwich midnight :—

	R.A. h. m. s.	N. Dec. ° ′
Jan. 31	23 37 33	6 21
Feb. 4	23 44 6	6 55
8	23 51 4	7 32
12	23 58 27	8 10
16	0 6 15	8 49
20	0 14 30	9 30
24	0 23 12	10 12
28	0 32 21	10 48
Mar. 4	0 41 28	11 23

The magnitude was 15·0 on December 30, but may be expected to reach at least 9·0 by the end of February. In 1852, when perihelion was at about the same time of the year, the comet was visible in bright twilight in February, but it has probably declined in physical brightness since that date.

SOLAR OBSERVATIONS AT MADRID.—In addition to the usual convenient astronomical and meteorological tables, the "Anuario" of the Madrid Observatory for 1918 includes the detailed results derived from direct photographs of the sun, observations of solar prominences, and spectroheliograms of the sun's disc taken in calcium light. The sun-spot record is for 1916, and gives the heliographic latitude and longitude of each spot, together with its duration, area, and classification. The prominence catalogue is also for 1916, and includes position, extent of base, height, and brightness of each prominence observed. A similar catalogue of calcium flocculi covers the period from October 1, 1916, to September 30, 1917. In addition, there are valuable discussions of the distribution of each group of phenomena in regard to time and position on the sun. In the case of calcium flocculi, the discussion covers the whole period of observation at Madrid, and is of particular interest because so few data have hitherto been published. The unit of time adopted is that of the sun's rotation, and the following mean daily numbers of flocculi for approximate years have been calculated from the table given :—

Period	Rotations	Days of observation	Mean daily number
1912, Apr. 4–1912, Dec. 5	1–9	131	1·247
1912, Dec. 5–1914, Jan. 18	10–24	169	0·704
1914, Jan. 18–1914, Dec. 12	25–36	128	1·499
1914, Dec. 12–1915, Nov. 4	37–48	134	4·782
1915, Nov. 4–1916, Dec. 17	49–63	149	7·506

SPECTRA OF JUPITER AND SATURN.—A photographic investigation of the spectra of the planets Jupiter and Saturn has been made at Glasgow by Dr. L. Becker (Monthly Notices R.A.S., lxxviii., 77). The spectra extended from B in the red to K in the extreme violet, and were about 11 cm. in length. Apparent absorption bands introduced by the dyes used to sensitise the plates were eliminated by the superposition of a positive photograph of the lunar spectrum. The only absorption band discernible in the spectra of the two planets is the well-known band in the red, which Dr. Becker finds to extend from λ 6174 to λ 6214. The supposition that water vapour is present in the atmospheres of these planets is not supported by the photographs in question, as the water-vapour lines near D do not differ in appearance in the spectra of the moon and planets.

THE SETTING OF CEMENTS.

A GENERAL discussion on the setting of cements and plasters was held by the Faraday Society on Monday, January 14, when several interesting papers were contributed. The subject is one of great technical importance, in view of the large and continually increasing application of calcareous cements, especially of the Portland class, in engineering and building work. Although this country leads in the manufacture of Portland cement, very little attention has been given to its chemical study by British chemists, and it is not surprising that the most important papers in the discussion came from France and the United States.

Whilst the setting of plaster of Paris is now agreed to be brought about by the crystallisation of a supersaturated solution, there still exists a difference of opinion as to the mechanism of the process in the case of Portland cement. The recent work of the U.S. Bureau of Standards, as described in a paper by Mr. A. A. Klein, supports the view, originally due to Michaëlis, that the products of hydrolysis are colloidal in nature, and that the desiccation and induration of gelatinous aluminates and silicates, and even of free alumina and silica, are responsible for the mechanical strength of the cement when set. On the other hand, the veteran cement chemist, Prof. Le Chatelier, to whom the first explanation of setting is due, reiterated his opinion that the process is essentially identical with the setting of plaster, the hardness being caused by crystallisation. Incidentally Prof. Le Chatelier offered some criticisms of the tendency, observable in much of the literature dealing with colloids, to use new technical terms as if they afforded an explanation in themselves, whereas they only express known facts in new language.

Dr. C. H. Desch, who opened the discussion, and Mr. Hatschek pointed out that the difference between the two schools is in great part one of terminology. It is agreed that the particles of the hydration products are usually too small to be distinguished, so that they fall within the region of ultramicroscopic dimensions, and surface forces become comparable with those which bring about the crystalline arrangement. Under such conditions it is almost immaterial whether the particles be described as crystalline or colloidal, especially in view of the work of von Weimarn, who has done much to show the continuity of the passage from one condition to the other with diminishing size of particles.

The contributions of Prof. Donnan, Dr. Lowry, and Mr. Hemming dealt with the agglomeration and disintegration of simple salts, and it was shown that these phenomena have a close connection with those of setting. In both cases the greater solubility of unstable as compared with stable solid phases plays a part. Dr. Rosenhain carried the discussion a step further by comparing the hardening of plasters and salts with the process of solidification of a metal. The solid formed in each case is a crystalline aggregate, which breaks more readily, under ordinary conditions, across the individual crystals than between their boundaries. This has been attributed to the formation of an amorphous intercrystalline layer, and it is possible that the strength of hydrated plaster may be due, not merely to friction between the interlocking radiating needles of adjacent spherulites, or to their simple adhesion, but to the presence of such amorphous material. Portland cement would presumably contain a much higher proportion of the amorphous products.

Another group of papers dealt with questions more closely allied to engineering practice, and the discussion rendered evident the fact, well known to those who have studied the somewhat complex subject of chemistry of cement, that there are numerous unsolved problems in connection with the setting and hardening processes, some of which bear in the most direct manner on the utility of cement and concrete as structural materials. Mr. Blount spoke of these difficulties from the point of view of the technical chemist, and Mr. Caröe from that of the architect. For the physical chemist some of the most interesting of these problems concern the spontaneous changes of setting time and their acceleration or inhibition in the presence of catalysts. The chemical constitution of Portland cement clinker is now established, thanks to the splendid work of the Geophysical Laboratory in Washington, a summary of which was given by Mr. Rankin, who was responsible for the investigation. The exact part played by impurities, such as magnesia, iron, and alkalis, still remains to be determined.

The addition of puzzolanic materials, containing soluble silica, has been practised since ancient times as a means of improving the qualities of lime mortar, and similar additions to Portland cement have been recommended. The work of the Bureau of Standards indicates that the strength after setting should be improved by such additions, and the practical question was directly raised in a paper by Messrs. Lewis and Deny, who showed a marked improvement in the strength of good brands of Portland cement, due to the addition of finely ground blast-furnace slag of suitable composition. The discussion brought out the fact that a difference of opinion exists on this question, although the evidence for improvement is very strong. Blast-furnace slag as a raw material for Portland cement manufacture has received little attention from chemists in this country, although the industry is now becoming an important one, and the utilisation of such a troublesome waste product deserves much closer study.

Discussions of this kind do a great service in reviewing the field for investigation in the branch of science or industry discussed, and also in bringing together work undertaken from quite independent viewpoints, the relations between which may have been quite unsuspected by the original investigators. Portland cement was an English invention, and this country has always led in its manufacture; it would be of advantage to the industry and to engineering if it were to receive more attention from British chemists than it has hitherto obtained.

C. H. D.

SECONDARY-SCHOOL EXAMINATIONS AND ADVANCED COURSES.

THE Consultative Committee of the Board of Education some years ago prepared a report on examinations in secondary schools, and this was published by the Board in 1911. Following the Committee's recommendation, the Board of Education invited the English universities to confer with representatives of the Board on the whole subject. These conferences took place during 1913, and in the same year the Board explained the general nature of the proposals it was about to make to representatives of local education authorities and associations of secondary-school teachers. In July, 1914, the Board issued the now well-known Circular 849, on "Examinations in Secondary Schools," and invited criticisms from responsible authorities upon the scheme proposed in it. The scheme provides for the annual examination of grant-earning schools in connection with the Board. Two examinations are proposed, and they are to be conducted by one of the recognised university examining bodies. The first examination is to be suitable for forms in which the average age of the pupils ranges from about sixteen

years to sixteen years eight months. The second examination will be designed for those who have continued their studies for about two years after the stage of the first examination. The first examination is intended to test the pupil's general education before he begins his school specialisation. It should, under certain conditions, serve the purposes of a matriculation examination, and it is hoped that eventually it will replace the numerous entrance and preliminary examinations to which pupils leaving the secondary school have had to submit themselves. The second examination will be based on the view that older pupils should have enjoyed a more concentrated study of a connected group of subjects, and the courses suggested in the Circular are (*a*) classics and modern history, (*b*) modern "humanistic" studies, and (*c*) science and mathematics. The Board's scheme naturally involves increased expenditure by the schools, and in Circular 849 the Board promised further financial aid, but in a later circular of December, 1915, it was announced that proposals involving increased financial aid were to be considered in abeyance. Circular 996, issued on May 25, 1917, however, announced the Board's ability to take up its examination scheme again, and the appointment of the "Secondary-School Examinations Council" to assist the Board to undertake its functions as the co-ordinating authority for secondary-school examinations. This council is at work, and the schools are awaiting its first report.

Closely connected with the two examinations which are being instituted by the Board of Education for pupils in grant-earning secondary schools is the scheme for the provision of advanced courses in such schools outlined in the "Regulations for Secondary Schools" issued by the Board last year. The Board states that the secondary schools are not sending forward to institutions of higher education and research a number of properly qualified students adequate to the national need. The Board regards this deficiency as due partly to an insufficient provision for advanced work in secondary schools, and to meet this need the new advanced courses have been planned. They are intended for pupils of about sixteen who have reached the standard of the Board's first school examination, and are to last for two years. The advanced course must be in one or other of three groups of subjects, the Regulations state:—(i) Science and mathematics, in which preponderance may be given to either; (ii) classics, *i.e.* the Latin and Greek languages, together with the literature, history, and civilisation of Rome and Greece; (iii) modern studies, which must include the study of (*a*) two languages other than English with their literature, (*b*) modern history on broad lines, and including the history of England and of Greater Britain, but also bearing special relation to the two languages chosen. Two, or even three, of these advanced courses may be organised in a large school, where pupils enough normally remain until about eighteen, but probably the number of advanced pupils in the school will not allow of more than one course. An additional grant for each of these courses is promised; it will not be calculated on the number of pupils and will in no case exceed 400*l*. Up to the middle of November last between 270 and 280 applications for recognition of advanced courses were received by the Board. About half of the applications were in respect of courses in science and mathematics; of the remaining half, those for courses in classics were little more than one-third of those for courses in modern studies. Up to the same date sixty-three courses in science, thirteen in classics, and nineteen in modern studies have been recognised. Nearly fifty were still undetermined. In the remainder (about 130) recognition was withheld, because the syllabus of instruction submitted was unsatisfactory, or because it was not shown that it could be satisfactorily carried out, or because a reasonable number of pupils qualified to enter on the course was not forthcoming.

GERMAN ECONOMICS AND TECHNOLOGY.

THE first meeting was recently held of the German Union of Technical Scientific Societies, formed by a combination of thirteen associations and unions, when problems involving economics and technology during and after the war were discussed. Prof. Dr. Wiedenfeld, of Halle, spoke on the subject, and showed that whilst, during recent pre-war years, Germany had become more and more dependent upon foreign countries for many articles of prime necessity, the blockade had thrown her back upon her own resources, and technical science had been called upon to furnish her requirements out of these, under conditions which were so far novel in that the question of cost of production became one of secondary importance. The problem had been met in three different ways:—

(1) By re-establishing industries that had been rendered unremunerative by foreign competition, such as the production of manganese, the increased production of iron, the production of sulphur, and the intensification of agriculture.

(2) By the increased utilisation of what had been waste products so much that the term "non-utilisable substance" had been eliminated by the war, examples being the production of lubricants from coal-tar and of clothing materials from various waste products.

(3) By the production of substitutes and of various substances by synthetic processes, as of nitro-compounds from atmospheric nitrogen, and of cattle feed from straw.

It is interesting to note that this speaker objected to the multiplicity of Government authorities controlling production, and holds that the production of materials in large quantities can be assured after the war only by means of monopolies, though not necessarily State monopolies. Finally, he insisted upon the immense importance of close co-operation between technical science and industry, neither of which can exist without the other. It need scarcely be added that many of these observations apply quite as forcibly to conditions in this country as to those in Germany.

THE NEW INTEGRAL CALCULUS.

THE ancient Greeks determined various areas and volumes by a method known as that of exhaustion; but they had no integral calculus properly so called, any more than (*pace* Prof. Burnet) they had a differential calculus, although they were familiar enough with the idea of a locus described by the motion (or flow) of a point. Even Fermat missed the analytical method devised by Barrow, Newton, and Leibniz. This was so rapidly developed as to assume a form which (except in notation) remained practically unaltered for a century and a half. The reason of this quiescence—a sort of dormant vitality—was the neglect of function-theory, or, rather, its non-existence. The appearance of Fourier's work on the theory of heat compelled mathematicians to study the properties of trigonometrical series, and the conditions under which they could be used for the representation of so-called arbitrary functions. Dirichlet and Riemann shed a flood of light upon the matter; and Riemann gave a definition of a definite integral which could be applied to functions more general than those that could be integrated

according to the older (say Newtonian) definition. In particular, the function to be integrated might have a finite number of isolated discontinuities in the range of integration; isolated, that is, in the sense of being separated by finite intervals. Thus a new type of integrals, the Riemann integrals, had come under observation.

Quite recently the whole theory of integration has entered upon a new phase, mainly through the development of the theory of sets of points, and the enlarged notion of "function" now established. To Lebesgue is due a definition of a definite integral which is applicable in certain cases even when Riemann's is not. The Lebesgue integral agrees in value with the Riemann integral when the latter exists; just as the Riemann integral agrees in value with the ordinary integral when the latter exists. The very latest contributions to the theory are mainly due to Vallée Poussin and Baire, and apparently a kind of finality has been reached in the mathematical notion of an integral, at least in the light of our present mathematical knowledge. Students will find an excellent summary in Prof. G. A. Bliss's lecture, "Integrals of Lebesgue," published in the Bulletin of the American Mathematical Society for October, 1917. The reader must have a fair acquaintance with the theory of sets (including the notions of measure and content); otherwise the lecture is self-contained. References to recent works on the subject are also given.

Few things are more remarkable than the mathematical discoveries of the present generation, discoveries which have profoundly affected the very rudiments and foundations of logic, analysis, and geometry. They cannot be ignored even by the elementary teacher, and the problem of making them familiar to students is one that must be resolutely faced. G. B. M.

METEOROLOGY IN THE ARGENTINE REPUBLIC.

A COPY has reached us of the *Boletin Mensual* of the Argentine Meteorological Office—a new monthly weather review that has now been running for more than a year. The data summarised refer to the year 1916, and are given in useful form. The tri-daily meteorological observations for twenty-five stations are printed *in extenso*, and an abstract of these, along with returns from other fifty-two stations, are given in an extended table. The elements summarised are pressure, temperature, relative and absolute humidity, direction of the wind, rainfall, cloud, and the number of frosts experienced.

The stations range in latitude from 55° S. to 22° S., and in height from 4 to 3447 metres, so that all climates are represented. Tables of *daily* rainfall are given for more than 1400 stations. The distribution, as is to be expected in a country like Argentina, where the meteorological posts are in general also railway stations, is very irregular. In the province of Buenos Aires, which embraces an area equal to that of the United Kingdom without Wales, there are 556 rain-gauge stations, but in the equally large territory of Santa Cruz there are only eleven stations. The results are shown in six coloured maps, giving the rainfall, the departure of the rainfall from the average, the accumulated rainfall since the beginning of the agricultural year, viz. July 1, with departures from the average, the mean temperature, pressure, and prevailing winds, and the extremes of temperature. Detailed hourly values of declination, horizontal force, and vertical force as recorded at the Central Magnetic Observatory at Pilar (lat. 31° 40′ S., long. 63° 53′ W.) also appear, along with a summary of the seismic phenomena recorded at several points with the Milne or Bosch-Omori seismographs.

The hydrometric branch of the service gives in each number of the *Boletin* the daily height of the principal rivers and lakes of the Republic as observed at fifty-eight places, with the departure from the average, also a special study month by month of the conditions at an individual station. So far the discussions refer to gauges at various points on the River Parana, where there are more than thirty years' observations available. Various interesting articles by members of the staff appear from time to time, and it is to be hoped that the prompt issue of meteorological data initiated by Mr. Wiggin, director of the Argentine service, will extend to other South American weather bureaux.

THE NEEDS OF OUR EDUCATION AT THE PRESENT DAY, WITH SPECIAL REFERENCE TO SCIENCE TEACHING.[1]

EARLY in the past year a work was published by a recently retired Ambassador which was understood in a special way to reflect the opinion of the Foreign Office. In this book he set forth the "necessary qualifications" for the diplomatic career, which in his opinion were "good birth, good breeding, good looks, and good health," and went on to say:—"Science is not necessary. Geography beyond elementary notions is not of great value. The diplomatist will acquire what geographical knowledge he needs of the country to which he is appointed while residing at the post. Few men can know it in sufficient detail beforehand."

We drifted into this war through sheer lack of expert knowledge of foreign countries and foreign languages. We have muddled and misconducted our war operations on sea and land through lack of expert knowledge, of science, on the part of those commanding at home, and sometimes—happily not always—of those commanding abroad. If by the proverbial good luck which saves Great Britain ever and again; if, still more, by the unparalleled bravery of our men in all branches of the combatant Services, by their innate common sense and coolness, and by the occasional streak of genius among their leaders, which not even a War Office or an Admiralty can occlude, we are sufficiently victorious to make peace on satisfactory terms, we shall need more than ever to reform our system of education and the general curriculum to be applied in all schools to the children and youth of both sexes. We shall not, I believe, conquer the Germans sufficiently in this round to be sure they will remain in the sphere allotted to them. We shall at best be able with the help of our Allies to turn them out of France, Belgium, and Italy, Serbia and Rumania, and leave them temporarily exhausted behind a frontier they only intend to respect until they regain strength. The one sure way to beat the Germans and keep them in their place is to become better educated than they are, and apply our new education to developing the resources of our own land and of the four or five million square miles in the tropics dependent on the London Government for direction.

Prior to the war, because of our contempt of a scientific education, we offered little or no inducement to our young men and women to serve the Home Country and the Empire in the application of science to industry, commerce, and the enlargement of the national intelligence. Therefore, we had to recruit our science teachers frequently from Germany. A great influx of clever men came to Britain from Germany under the ægis of the Prince Consort and from

[1] From the presidential address delivered before the Association of Public-School Science Masters on January 8 by Sir H. H. Johnston, G.C.M.G., K.C.B.

the awakened interest in art and science he left behind him. They became scientific pioneers in African exploration, professors of philology, of Sanskrit, of Celtic languages, of forestry, botany, zoology, chemistry, and history. They excelled in Oriental studies, in botany, and in chemistry, and rendered yeoman service to British industrial and mental development. Most of them are dead—happily dead before this horrible war revealed the dreadful, the unforgivably cruel side of Imperial Germany. A few are pensioned off, but their names are indelibly inscribed in the history of the British Empire, if that history be truly written. A few have returned to Germany. But never again, within the lifetime of the youngest man present, shall we send to Germany for instructors in any branch of learning.

Consequently, it is more than ever vitally necessary that we should reorganise our education, and produce as home-bred articles all the botanists, philologists, foresters, zoologists, entomologists, chemists, astronomers, translators of Oriental manuscripts, and musicians we require for our home needs and for the Empire dependent on our initiative. We shall not do this efficiently with our existing ideals of education at the great and small schools.

But we require not only to train British biologists, astronomers, ethnologists, philologists, historians, chemists, and a hundred other diverse types of specialists, but equally we need to give a glimmer, a general idea of these branches of science to all the people of the realm. Geography must bulk largely in popular education; some idea should be given of the earth's age and structure; elementary notions of astronomy, zoology, and botany are highly necessary to the mental equipment of the masses; and ethnology is of equal importance with geography. The history of Great Britain and Ireland should be taught intelligibly and truly, not in the Mrs. Markham style, nor with the prejudices of Macaulay or Father Benson. Something of human anatomy and much about the laws of health should be in the curriculum of even the humblest school. An elementary knowledge of arithmetic and a thorough knowledge of the English language—its origins, its right conventional pronunciation, and its weird and wicked orthography; an introduction to the masterpieces of English literature; smatterings of Latin, Greek, and French—sufficient to understand the part these languages have played in the formation of our vocabulary; a generalised explanation of electricity and the simplest and most important facts of chemistry: these, it seems to me, with the teaching of a good handwriting and the clear expression of thoughts on paper and a little freehand drawing, are the essential subjects of the basic education which should be given to every child in the kingdom between the ages of six and fourteen.

Building on such a base, we can then branch out along the lines of specialist education: Shorthand, after longhand; the phonetic writing of English, after the preposterous artificiality of conventional spelling; foreign languages after our own; drawing and painting for those who incline to the pictile arts; music for all who are musical; anthropology and ethnology in their diverse ramifications for the future traveller, clergyman, administrator, or police-court magistrate; geometry, geodesy, mechanics, hydrostatics, and physics, and the higher mathematics for the predestined surveyor, builder, engineer, or astronomer; chemistry and agriculture, animal pathology for the farmer-in-grain; chemistry, again, and all the outgrowths of that mighty chapter in the New Bible for the intended manufacturer and tradesman; ballistics for the cadet; botany, entomology, sociology, modern history, law, and languages for the future statesman; and the differential calculus for those who crave an opportunity of applying it to some more practical purpose than merely passing as Senior Wrangler.

Education, it seems to me, comes under three heads: (1) That which deals with the necessities of man's body—gymnastics, training of the eye and ear, the development of the muscles, skill with weapons or utensils, the strengthening of the nerves, the making of each girl and boy into as healthy and fit a member of the community as is possible; the teaching of all the mechanical and constructive arts that go to feeding our bodies and minds, sheltering us, transporting us from place to place, and clothing us. (2) That which supplies the requirements of man's mind, all useful learning regarding the past, the place of our planet in the Cosmos, the other forms of life that share the earth with man, the interpretation of the great New Bible—in short, the Book of the Earth—itself, which we are just learning to read, and those other lesser books, the products of the human mind; not only the documents left to us from the pre-Christian Mediterranean world, but also the great literatures of India, of Scandinavia, of China and Japan, of Renascent Italy, England, France, of the Aztecs in Mexico, and of the Semitic and Hamitic peoples. (3) That of the education of the soul.

This last is a much-abused word, the precise meaning of which no one can define to the liking of his neighbour. It is the imponderable, "insaisissable," imperishable spirit of the race which we also call "character" and "disposition"; which is referred to poetically as "heart" in contradistinction to "head." It is almost universally agreed that the education of the impressionable young cannot be confined to the cultivation of muscles and the steadying of nerves, to the care of the teeth and the removal of adenoids, to the initiation into the mechanical arts and the decorative arts; nor to the filling of the mind with an encyclopædia of useful information. You have, in addition to caring for mind and body, to impart such education as may—here with great, there with only partial, success—turn the raw material of your pupils into good men and women, honest servants of the State, enthusiastic patriots, and law-abiding citizens, obeying, however, wise and humane laws which they are competent to frame or to understand.

Into this third great branch of education science, founded on demonstrable truth, alone must enter; superstition must be banned. The scientific basis and authority for temperance and chastity must be explained; children must be shown that wrongdoing against one's self or the community does not pay in the long run—that against one's own body and mind it is rapidly punished; that against the community not only are there unpleasant consequences through the enforcement of laws which we have made for the protection of the community, but also that the wrongdoer himself would suffer in security and happiness were there no such laws.

THE METEOROLOGICAL RESOURCES OF THE EMPIRE.[1]

IN many directions steps are being taken to survey the resources of the Empire and to plan how these may best be utilised in the general reconstruction which must undoubtedly be taken in hand on the cessation of hostilities. In meteorology the same should be done, for within the Empire we may meet every type of climate. The great Overseas Dominions, India, the Colonies, and especially the oceanic islands, not only afford the means for extend-

[1] Abstract of the presidential address delivered before the Royal Meteorological Society on January 16 by Major H. G. Lyons, F.R.S.

ing our knowledge of the direction and velocity of the currents of the upper air, to meet the demands of aviation, which will become greater in the near future, but with a very moderate increase in the resources of their existing institutions, and more active co-operation, they may powerfully aid in the solution of many meteorological problems of theoretical and practical importance.

But the organisation of the Empire's meteorology at the present time is very far from being adequate, for the provision of stations has grown out of local needs or individual initiative, not from a considered plan. When we examine the meteorological organisations of the Empire we may well be astonished at their extent and their development, but as we look further into the matter we shall see that we are still far from utilising them to the best advantage, for reasons which will appear.

In all countries where there is a meteorological service the network of climatological stations is controlled by one or more first-order stations, or meteorological observatories, at which continuous records or hourly readings of pressure, temperature, wind, sunshine, rain, etc., are taken, but none as yet exist in the great Colonial regions of East Africa, West Africa, or in the West Indian Islands, though there are eighteen institutions of this class in other parts of the Empire.

The work of the meteorologist does not end with recording the pressure, or the temperature, or the monthly amount of the rainfall, but meteorological observations, after being taken, must be worked up into the various forms in which they will be most useful for shipping, agriculture, water-supply, engineering, sanitation and health, and now, also, aerial transport. The same form will not suffice for all, and meteorology itself has its own especial needs, but the important thing is that this information, however accurate and detailed it may be, will not be available in exactly the forms that answer to different requirements unless there is a sufficient staff of trained meteorologists to handle it and to supervise its preparation.

Nor is the study of a single region sufficient in itself. India, in preparing the monsoon forecast, draws upon data from Egypt, St. Helena, Brazil, etc.; Egypt, in forming each year an estimate of the coming Nile flood, utilises information from India, Uganda, the South Atlantic, and so on. The East Indian Islands need warnings of their hurricanes from the more eastward islands of their archipelago, and must utilise all that Asia and Africa can tell them about the development and movement of tropical storms before their precautions can be considered to have exhausted all the means available. All lands which lie near the subtropical zones of scanty rainfall are vitally interested in the problems of forecasting the probable sufficiency or failure of their rainy season. The droughts of the pastoral regions of Australia and South Africa are well known, and the same occur in the Sudan, though from its retarded development less has been heard of them up to the present time, but in the future, as the population increases and becomes more settled, the same considerations will demand attention. Similarly, the countries in temperate zones find some of their most urgent problems in the adequacy or inadequacy of the summer heat for the ripening of cereal crops.

We are far from having solved these problems, but we know enough to say definitely that they cannot be solved from the study of a single region, but that they are world-problems in which the meteorological conditions of the whole world must be considered, and for studies of such vast importance the British Empire offers unequalled opportunities, which must be seized and fully utilised. It is in the development of our science within the Empire that there are opportunities by which we have hitherto profited inadequately.

In East and West Africa we have two large groups of Colonial possessions having closely related climates and being already in possession of a number of meteorological stations with records extending over a considerable number of years. It should not be beyond the wit of man to devise a workable system of co-operation for these stations so as to form for each a service which should have a meteorological observatory as its technical centre, with one or more trained meteorologists to direct its energies and to utilise the collected information for the use of the Colonies themselves and of the Empire as a whole.

Already a secular decrease in the annual rainfall of Nigeria has been not merely suggested as being indicated, but also announced by some as a fact, so that the confirmation or confutation of this contention is a matter of very urgent importance to the Colony. Such questions as these are best investigated on the spot by a trained meteorologist in the first instance, even though the final stages in the inquiry may require reference to the meteorological authorities of other regions for the results of their investigation into similar or related questions.

After considering in detail our meteorological organisation we find that within the Empire there are already upwards of 1000 climatological stations distributed all over the world, from lat. 60° N. to lat. 54° S., near the equator, within the tropics, and in the temperate zone. They are on coast-lines, in the heart of continents, and on oceanic islands. Some few, especially in India, are at high altitudes above sea-level. They therefore furnish us with opportunities for investigating almost any problem that may arise in meteorology if competent meteorologists make full and proper use of them.

We come, then, to the conclusion that, in order to provide trustworthy and adequate information regarding the climate of the Empire, and the meteorological phenomena which play so important a part in the lives of all the inhabitants of the earth, a more efficient organisation of our meteorological resources is necessary. In the first place, men will be required who have received a good training in modern meteorology, and have such a knowledge of physics and mathematics as will enable them to deal with the problems which they meet. Hitherto there have been very few of these men in this country, but the present needs have brought a number into direct contact with the subject, and if the meteorological services of the Empire are going to offer a career to an able meteorologist, some of them may elect to adopt it. Co-operation and intercommunication will be all the more essential and valuable when the meteorological work is entrusted to specially trained men who have seriously studied the subject, and this society should be able by means of its meetings, and especially by its Journal, to aid powerfully in the attainment of this desirable object.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The Department of Physiology is about to undergo extension. The work of the teachers of physiology has been divided. Dr. H. S. Raper has been appointed professor of physiology and biochemistry, and Dr. C. L. Evans has been appointed to a new chair as professor of experimental physiology, or, as it will probably be called, "experimental physiology and experimental pharmacology." This change illus-

trates the trend of modern medicine and surgery. It is becoming evident that an increasing contribution to their progress is rendered possible by a detailed study of the chemical processes met with in health and disease, and the influence upon them of substances of known chemical composition. Recent investigations furnish an example. Antiseptic action of substances containing active chlorine was undertaken early in the war by the University in conjunction with Dr. H. D. Dakin. These researches led to the introduction of two antiseptics, chloramine-T and dichloramine-T, which have been widely used in the treatment of war wounds. To carry out efficiently the new schemes involved in the above changes, increased laboratory accommodation for research will be necessary, and additions to the apparatus in the Department of Physiology must also be provided. Prof. Raper was appointed, in 1910, lecturer in pathological chemistry at the University of Toronto, and held that post until his appointment in 1913 as lecturer in physiological chemistry at Leeds University. He is now on military service. Prof. Evans is also on military service. His published works comprise a number of valuable papers on subjects of physiology and chemical physiology. In the important branch of the medical school—that which relates to pathology and bacteriology—there are also likely to be interesting developments in the near future.

A COURSE of four advanced lectures on "The Electrical Examination and Treatment of Affections of the Nervous System" will be given by Dr. A. D. Waller and Miss M. D. Waller in the Physiological Laboratory of the University of London, South Kensington, on February 5, 12, 19, and 26, the admission to which will be free, without tickets.

A COURSE of nine public lectures on "Animal Life and Human Progress," arranged in conjunction with the Imperial Studies Committee of the University of London, to be given on Wednesdays at 5.30, will open at King's College on January 30 with a lecture on "Man's Account with the Lower Animals," by Prof. Arthur Dendy. The other lectures to the end of February will be:—Some educational and moral aspects of zoology, Prof. G. C. Bourne; Museums and research, C. Tate Regan; Man and the web of life, Prof. J. Arthur Thomson; The origin of man, Prof. F. Wood Jones. Admission to the lectures is free. Cards for the course may be obtained from the Publications Secretary, King's College, Strand, W.C.2.

IN connection with the work of the Imperial Studies Committee of the University of London, a course of public lectures on "Some Biological Problems of To-day" is being delivered at University College on Mondays at 4 p.m. The course began on January 21, and the first five lectures are:—(1) The problem of food, Prof. W. M. Bayliss; (2) War bread and its constituents, Prof. F. G. Hopkins; (3) Accessory food factors (vitamines) in war-time diets, Miss E. Margaret Hume; (4) Alcoholic and other beverages, Prof. A. R. Cushny; (5) The possibilities of increased crop production, Dr. E. J. Russell. The lectures are open to the public without fee or ticket.

THE early introduction by Mr. Fisher of an amended Education Bill, referred to last week, shorn of the more objectionable administrative features of the original Bill, has given general satisfaction. It says much for the credit and courage, no less than for the sincerity, of Mr. Fisher and his educational ideals that he has not failed to take note of the strong feeling evinced, throughout the country during his educational campaign, against any further increase of bureaucratic control with respect to the Board of Education. Parliament is justified in declaring a policy, but it must be left to the local authorities to give it full effect. The Act of 1902, whilst it made the county and borough councils responsible for all forms of education within their areas, failed to make the obligation mandatory. In the present Bill this is remedied, and now they must submit schemes for the approval of the Board to give effect to its requirements, and since the Board commands under the proposed system of consolidated grants large financial control up to 50 per cent. of the total local expenditure, it can readily call upon recalcitrant authorities to fulfil the conditions laid down. Probably the most difficult will be, having regard to industrial conditions, to the requirements of agriculture, and to the scattered and remote character of certain rural areas, to make satisfactory arrangements in respect of the clauses of the Bill which are designed to secure the continued education of young people between fourteen and eighteen. Many different solutions will be required according to the special circumstances of industries and localities. Wide and far-reaching as are the provisions of the Bill, it is, after all, a tentative measure, leading, it is to be hoped, to further developments, in the near future, alike in the provision of maintenance for children declared fit for fuller educational opportunities, in ensuring more complete measures for the care of child-life from the earliest age, and in the raising of the compulsory school age to fifteen, as in the Scottish Bill. The educational features of Mr. Fisher's Bill have met with general approval, and it may be now anticipated with confidence that early in the new session Parliament will give the Bill legal effect.

THE Principal, Dr. R. Mullineux Walmsley, in his report at the prize distribution of the Northampton Polytechnic Institute on January 19, said the manufacture of high-class munitions upon a commercial scale, commenced on July 1, 1915, had been continued uninterruptedly to the present time. In the Technical Optics Department the work of training women students in full-time classes in lens- and prism-grinding was vigorously prosecuted. This department has been highly successful, and the value of its work with reference to the prosecution of the war cannot be exaggerated. Attendances at other classes followed much the same course as in the preceding session, the chief feature being the continual draining off of the senior men both for actual service in the forces and for munitions work. As usual, the work has continued to receive the cordial support of the trades affected. What was described in the last report as "looking forward" work, namely, the training of disabled sailors and soldiers to take their places in the life of the country, not only now, but also after the conclusion of the war, was continued. To the end of July, 1917, eleven complete courses for training suitable men as electric power sub-station attendants were given, and the whole of the men trained were placed out. In the session now running further courses have been given, and the sixteenth course of the series has been started. Fifty-eight members of the staff, 542 members and students, and 802 students have joined the colours, and there are 104 V.A.D.'s serving in military hospitals abroad and at home. Of those joining the forces 169 have obtained commissions. Another line of work is the placing of the equipment and staff of the polytechnic at the disposal of the Government. From time to time various members of the senior staff in different departments have been requisitioned for experimental and scientific work intended to aid the prosecution of the war, and as the equipment of the laboratories is, in many directions, very complete, a considerable amount of work has been done.

THE eighteenth annual general meeting of the Association of Public School Science Masters, held on January 8 and 9 at the City of London School, was remarkable for the unanimity shown by members on certain important points. The main aim of the association at the present moment is to make it certain that every boy in the public schools should receive training in natural science. This training should be part of the general education of the boys, and should therefore be on lines suitable for those who will not afterwards make science their special study. Such lines were laid down by the association twelve months ago in a pamphlet known as "Science for All," in which prominence was given to the human and biological aspects of the subject. Since this is non-specialist training, it must be taken in the schools before the average boy reaches the age of sixteen and a half, when a certain degree of specialisation usually begins. These points were referred to by Mr. O. H. Latter, who explained to the members the far-reaching effects of university entrance examinations on curricula. The committee, he said, had been met very sympathetically by Oxford University in this matter, and negotiations were still going on with Cambridge. During the discussion which followed, the Board of Education policy of grouping science with mathematics in these examinations was severely criticised. No enthusiasm was shown for the introduction of "compulsory science" in such examinations, if the main aim can be attained in any other way; on the other hand, the general feeling of the meeting was in favour of removing compulsion (so far as this means that failure to pass in one subject alone necessarily prevents a boy from passing to the university) from all subjects, with the sole exception of English. The moderateness of the association was shown again later, when the following resolution was passed unanimously:—"That it is desirable that opportunities be given to candidates for science scholarships to offer a historical or other literary subject as subsidiary to their main one." Extracts from Sir H. H. Johnston's presidential address are given elsewhere in the present issue.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, January 9.—Dr. Alfred Harker, president, in the chair.—L. D. **Stamp**: The highest Silurian rocks of the Clun Forest District (Shropshire). Clun Forest is a district in which Upper Silurian rocks crop out over a wide area, interrupted by outliers of Old Red Sandstone. The district is separated from the typical Silurian area of Ludlow by the great line of disturbance that passes through Church Stretton and Old Radnor. The succession of beds compares closely with that in the Ludlow district. The main differences are:—(1) That the Aymestry Limestone is represented by mudstones west of the great fault-line, and (2) that all other divisions show increased thicknesses. There is no evidence of any stratigraphical break. The sequence is complete from the Lower Ludlow rocks up into the Old Red Sandstone, and the changes in lithology are gradual. The extent of Old Red Sandstone, as indicated on present maps, must be restricted, since most of the supposed Old Red Sandstone has been found to belong to the Temeside group, which here attains a great development. The Silurian age of the beds is shown by the occurrence of *Lingula minima* and of characteristic lamellibranchs. A comparison with other districts in which Upper Silurian rocks are developed shows that deposition attained its maximum along the Welsh Border, the thickness of the formations decreasing rapidly southwards and eastwards. On the east of the district—in the neighbourhood of the fault-line—the strata are folded along axes ranging north-north-eastwards parallel to the main fault. Away from the major faults the folding is gentler, and folds ranging nearly due east and west make their appearance. Farther west the north-north-eastward folding and fracturing reappear.

Mineralogical Society, January 15.—Mr. W. Barlow, president, in the chair.—Dr. J. W. **Evans**: Diagrams expressing the composition of a rock. These diagrams are intended, like those of Michel Lévy and Mügge, to indicate at a glance the significance of the analysis of a rock or complex mineral silicate. The molecular proportions of the constituents are determined in the usual manner, those of the ferrous and magnesium oxides, however, being doubled. The silica is represented by two rectangles placed side by side, the length of each being half the molecular proportion of silica. In one of these rectangles lengths equal to the molecular proportions of potash, soda, and lime are measured off in succession, and in the other those of alumina, iron oxide, and magnesia. Thus the same space represents both metallic oxide and silica, and so far as felspars, felspathoids, or ægirine are actually or potentially present, the monoxide and sesquioxide they contain are, with two molecules of silica, represented by contiguous portions of the two rectangles. The excess, if any, of lime over available alumina has the silica necessary to form wollastonite, and the excess, if any, of iron oxide over available soda and the magnesia have the silica required to form orthosilicates. The remaining silica space is then divided up to show the additional silica required or available for the felspars, felspathoids, and ægirine, and that available to convert the orthosilicates of iron and magnesium into metasilicates. The remainder represents free silica or quartz.—Dr. G. F. H. **Smith**: The use of the gnomonic projection in the calculation of crystals. If projected on to a plane at right angles to the edge of the zone containing the poles from which bi-angular measurements were made, the diagram takes the form of a net, the nodes of which represent the principal poles. The unit lengths of the net are easily calculated from the data, and once the rectangular co-ordinates of any node with respect to axes on the diagram have been determined those of the remainder follow by simple addition or subtraction; the corresponding spherical angles are deduced by a simple calculation. The accuracy of the calculations may be checked from the diagram at every step. To keep the projection corresponding with any crystal within reasonable dimensions it is sometimes convenient to project on to the faces of a cube. The direction of a zone when crossing from one face to another is very simply found from the diagram.

Mathematical Society, January 17.—Major P. A. **MacMahon**: A method for studying any convergent series.—G. H. **Hardy**: Additional note on Dirichlet's divisor problem.—J. H. **Grace**: Note on a Diophantine approximation.—K. Amanda **Rau**: A note on a theorem of Mr. Hardy's.—C. H. **Forsyth**: Super-normal curves.—Prof. H. **Hilton** and Miss D. S. **Tuck**: Plane quartic curves with a tac-node.

PARIS.

Academy of Sciences, December 31, 1917.—M. Ed. Perrier in the chair.—A. **Lacroix**: The eruption of the Quetzaltepec volcano and the earthquake that destroyed San Salvador (June–July, 1917). A detailed account of the eruption, gathered from the statements of eyewitnesses and from photographs, is given. The great loss of life and damage were mainly due to the earth-

quakes.—M. **Hamy**: A particular case of diffraction of the images of circular stars.—E. **Ariès**: The necessity of improving the Clausius equation of state. In the Clausius equation

$$p=\frac{RT}{v-a}-\frac{\phi(T)}{(v+\beta)^2}$$

it is proposed to replace the two constants α and β by two functions of the temperature, and it is shown that the main advantages of the original equation are not lost.—A. **Blondel**: The direct measurement of the angle of internal decalage of an alternator.—G. **Julia**: Rational substitutions.—M. **Akimoff**: Fourier-Bessel transcendentals with several variables.—M. **Mesnager**: The rigorous demonstration of the formulæ of rectangular beams and plates.—A. **Léauté**: Complement to M. Blondel's theory on the induction reaction of alternators.—F. **Delhaye** and M. **Sluys**: The erosion valley of the Congo and its tectonic antecedents.—P. **Brodin** and F. **Saint-Girons**: Researches on the leucocytes of blood from tuberculous subjects. For data to be of value, the leucocytes must be taken daily for a considerable period. The higher the proportion of polynuclear leucocytes, and the higher the total number present, the graver the prognosis.—MM. **Nicolle, Fayet,** and **Truche**: The treatment of epizootic lymphangitis by means of autolysed yeast juice. An account of the technique proposed and the results obtained.—F. **Diénert**: What are activated muds? The muds causing rapid nitrification of sewage contain chalk (50 per cent.) and albuminoids (20 per cent.), the remaining 30 per cent. being non-albuminoid.—J. **Belot** and H. **Fraudet**: The localisation of foreign bodies in the eyeball and the muscles of the eye.—A. **Cabanes**: Antiseptic treatment by chloroform. A stream of oxygen containing alcohol and chloroform vapour is circulated through the wound. Purulent secretions diminish rapidly under this treatment, and leucocytic reactions are increased.—J. **Bridré**: Leucocytotherapy or aseptic pyotherapy. Its use in lymphangitis of the horse.

BOOKS RECEIVED.

The Advanced Montessori Method. By M. Montessori. i., Spontaneous Activity in Education. Translated by F. Simmonds and L. Hutchinson. Pp. vii+357. (London: W. Heinemann.) 6*s*. net.

Annuaire Astronomique et Météorologique pour 1918. By C. Flammarion. Pp. 364. (Paris: C. Flammarion.) 3 francs.

The Wellcome Photographic Exposure Record and Diary, 1918. Northern Hemisphere and Tropics. Pp. 256. (London: Burroughs Wellcome and Co.)

Resistance of Air. By Lt.-Col. R. de Villamil. Pp. x+192. (London: E. and F. N. Spon, Ltd.) 7*s*. 6*d*. net.

Short Logarithmic and other Tables. By Dr. W. C. Unwin. Sixth edition. Pp. 43. (London: E. and F. N. Spon, Ltd.) 1*s*. 6*d*. net.

The Practice of Pharmacy. Sixth edition. By Dr. J. P. Remington, assisted by E. F. Cook. Pp. xxviii+25–1987. (London: J. B. Lippincott Co.) 35*s*. net.

The Gate of Remembrance: The Story of the Psychological Experiment which Resulted in the Discovery of the Edgar Chapel at Glastonbury. By F. B. Bond. Pp. x+176. (Oxford: B. H. Blackwell.) 6*s*. net.

Educational Reform. By the Rt. Hon. H. A. L. Fisher. Pp. 15. (London: Longmans and Co.) 2*d*. net.

Troubles Locomoteurs Consecutifs aux Plaies de Guerre. By Prof. A. Broca. Pp. 155. (Paris: Masson et Cie.) 4 francs.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 24.

ROYAL SOCIETY, at 4.30.—Graphical Solution for High-angle Fire: Prof. A. N. Whitehead.—Flocculation: Spencer Pickering.—Revolving Fluid in the Atmosphere: Dr. J. Aitken.—Ultra-violet Transparency of the Lower Atmosphere and its Relative Poverty in Ozone: Hon. R. J. Strutt.—The Presence in the Solar Spectrum of the Water-vapour Band λ 3064: Prof. A. Fowler.—The Ultra-violet Band of Ammonia and its Occurrence in the Solar Spectrum: Prof. A. Fowler and C. C. L. Gregory.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Telephone Exchange Transfers and their Organisation: F. G. C. Baldwin.

FRIDAY, JANUARY 25.

ROYAL INSTITUTION, at 5.30.—The Motion of Electrons in Gases: Prof. J. S. Townsend.

PHYSICAL SOCIETY, at 5.—Presidential Address: Prof. C. V. Boys, F.R.S.

SATURDAY, JANUARY 26.

ROYAL INSTITUTION, at 3.—The Chemical Action of Light: Prof. W. J. Pope.

MONDAY, JANUARY 28.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—East Africa: General Smuts.

ROYAL SOCIETY OF ARTS, at 4.30.—High-temperature Processes and Products: C. R. Darling.

TUESDAY, JANUARY 29.

ROYAL INSTITUTION, at 3.—Palestine and Mesopotamia: Prof. Flinders Petrie.

WEDNESDAY, JANUARY 30.

ROYAL SOCIETY OF ARTS, at 4.30.—The Manufacture of Margarine in Great Britain: Sir William G. Watson, Bart.

THURSDAY, JANUARY 31.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Growth of Trees: A. Mallock.—Action of Light Rays on Organic Compounds, and the Photosynthesis of Organic from Inorganic Compounds in Presence of Inorganic Colloids: Prof. B. Moore and T. A. Webster.—The Isolation and Serological Differentiation of *Bacillus tetani*: Capt. W. J. Tulloch.—An Investigation into the Periodicity of Measles Epidemics in the Different Districts of London for the years 1890–1912: Dr. J. Brownlee.

ROYAL INSTITUTION, at 3.—Revolving Fluid and the Weather Map: Sir Napier Shaw.

FRIDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 5.30.—Gravitation and the Principle of Relativity: Prof. A. S. Eddington.

SATURDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 3.—The Ethics of the War: P. H. Loyson.

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THURSDAY, JANUARY 31, 1918.

SOME CHEMICAL MANUALS.

(1) *Treatise on Applied Analytical Chemistry: Methods and Standards for the Chemical Analysis of the Principal Industrial and Food Products.* By Prof. V. Villavecchia and others. Translated by Thomas H. Pope. Vol. i. Pp. xvi+475. (London: J. and A. Churchill, 1918.) Price 21*s.* net.

(2) *Trattato di Chimica Generale ed Applicata all' Industria.* By Prof. E. Molinari. Vol. i., *Chimica Inorganica.* Parte Prima. Quarta edizione, riveduta ed ampliata Pp. xiv+560. (Milano: Ulrico Hoepli, 1918.) Price 12.50 lire.

(3) *Notions Fondamentales de Chimie Organique.* By Prof. C. Moureu. Cinquième édition, revue et considérablement augmentée. Pp. vi+548. (Paris: Gauthier-Villars et Cie, 1917.) Price 20 francs.

(4) *Reagents and Reactions.* By Prof. E. Tognoli. Translated from the Italian by C. Ainsworth Mitchell. Pp. viii+228. (London: J. and A. Churchill, 1918.) Price 6*s.* net.

(1) PROF. VILLAVECCHIA, the director of the chemical laboratories of the Italian Customs, has compiled this useful treatise for the purpose of facilitating the examination of industrial and alimentary products, and of the raw materials of their manufacture. It would seem to be especially designed for the exact characterisation and valuation of commercial products by experts and inspectors appointed to enforce contractual conditions in connection with the purchases and supplies of the State. It is, in fact, such a book as might be put together by the head of our own Government laboratory for the use of the members of his department. It covers, however, a far wider range of analytical work than usually falls to the lot of a Government chemist in this country, who is seldom called upon to make many of the very specialised analyses which are treated of in this book, as they have no direct connection, as a rule, with the requirements of the State. In the few exceptional cases in which such examinations are needed special arrangements are made. The Government departments in this country have probably much larger and wider facilities for enlisting the services of specialist analytical experts than is the case in Italy, which may account, therefore, for the comprehensive scope of Prof. Villavecchia's work, which was primarily designed for use in his own department.

The book treats of the analysis of potable waters and water for industrial purposes; of the examination of a great variety of chemical products, inorganic and organic, such as the common acids, alcohols, esters, salts, mordants, sulphur, etc.; of the more important fertilisers; of cement materials; metals and alloys; fuels; mineral oils and their derivatives; fatty substances; and a variety of industrial products obtained by the treatment of fatty matters, such as stearine, soap, glycerin, hydrogenised oils, etc.

The methods, as a rule, are judiciously selected with special attention to the particular point to be ascertained, and with due regard to the limitations of time imposed on official work of the kind, where it often happens, as in tender samples, that large numbers have to be dealt with as quickly as possible. At the same time the analytical processes are scientifically sound, and capable of affording a satisfactory degree of accuracy. Most of them have been repeatedly tried in the laboratories under the author's direction, and in cases where the methods yield results which are only relative to the procedure employed, the conditions needed to ensure strictly comparable results have been carefully studied. Mr. Pope, the translator, has made some additions and modifications in order to render the work more applicable to conditions in this country, but the departures from the Italian text are few and comparatively unimportant. We can confidently recommend the book to all analysts who are concerned with the analytical examination of the various classes of material of which it treats.

(2) Dr. E. Molinari is professor of chemical technology in the Milan Polytechnic. His work under review, now in its fourth edition, was first published in 1904. The fact that it has passed through so many editions in such a comparatively short time is a sufficient indication of its success in meeting the demand in Italy for a comprehensive treatise on chemistry, both general and physical, applicable to the arts and manufactures. The present volume is concerned with the inorganic (non-metallic) division of the science. It has been carefully revised and brought up to date, and is fairly well illustrated. It contains, for example, an excellent account of modern methods of making sulphuric acid, with special reference to the various contact processes in use in Germany and England, with diagrammatic representations of the plant as shown in the patent specifications. The methods of liquefying air and the fractional separation of its main components, as practised on the large scale, are well described and illustrated, as are the methods for the utilisation of atmospheric nitrogen, so far as these have been made public. The book is admirably printed in excellent type on good paper, and is a thoroughly sound and eminently readable treatise.

(3) Prof. Moureu's "Notions Fondamentales de Chimie Organique," now in its fifth edition, is too well known to need any detailed account. The present volume is, of course, necessarily enlarged in order to do justice to the growth of knowledge since its first issue in 1902, but in its general plan and arrangement it differs in no essential particulars from its predecessors. The author has added some pages on new developments of the atomic theory, with special reference to valency, and the article on stereochemistry has been recast. Special attention has been paid to the treatment of the connection between physical properties and chemical constitution, and some account is given of the mechanism of chemical change. The book already enjoys the distinction of being one of the most generally preferred text-books on its subject

in the French universities, and is by no means unknown in the chemical schools of other countries. The care which is evidently taken in revising it, and the frequency of its reappearance in the form of new editions, will tend to ensure a continuance of its popularity.

(4) Prof. Tognoli's little book on "Reagents and Reactions," translated from the Italian by Mr. C. Ainsworth Mitchell, supplies an omission and serves a very useful purpose. As the translator points out, it is a common practice to refer to a reaction by the name of the chemist who first devised it. Indeed, in many cases there is no other convenient method of designating it. Thus we speak of the Marsh and the Reinsch tests for arsenic, the Nessler test for ammonia, the Baudouin test for sesame oil—to confine oneself to well-known examples. But some examples which might be quoted are far from well known—many are obsolete and some are wholly forgotten. Physiological chemists, and medical men who dabble in physiological chemistry, are especially prone to associate their names with minor qualitative tests for pathological and similar products, such as albumin, biliary pigments, gastric juice, urine, *et hoc genus omne*. Most of these tests find no permanent place in chemical literature, but reference to them may occasionally be made in special papers with no mention of their exact character. On the other hand, there are, of course, others which have been found of great value and are in constant use.

The author has gathered together a list of the more important reagents commonly employed in such testing, arranging them in alphabetical order and indicating the means of ascertaining their purity. He then gives a more or less detailed account of reactions arranged in the alphabetical order of the names of their discoverers or of those persons with whose name the test is commonly associated—which is not in all cases the same thing. Condensed as the descriptions of the tests are, the list extends to nearly 140 pages. It is probably sufficiently complete, and we may be reasonably certain that no important chemical reaction of the kind has been omitted; the book therefore adequately fulfils the intention of the author. In a collective index at the end of the volume the various names are gathered together in connection with the substances for which the tests were devised, arranged in alphabetical order. Thus we have thirty-two names in connection with albumin, fifty-two in connection with alkaloids, fifty in connection with dextrose (mostly in urine), and no fewer than 126 in connection with that particular fluid itself. A useful feature in the book is a description of various test-papers for acids and bases; others for special tests, such as for ozone, nitrites, oxygen, hydrogen peroxide, carbohydrates, oxidising and reducing substances, etc. There is also a short list of test-papers found useful in clinical tests, *e.g.* the tropæolin paper of Boas-Lücke for detecting the acids of the gastric juice; Geissler's potassium mercury iodide and citric acid paper for detecting albumin in urine; Olliver's indigo-carmine and sodium carbonate paper for the recognition of dextrose in urine, etc. There are also tables, by recognised authorities, showing the specific gravities of aqueous solutions of ammonia, caustic potash and soda, potassium and sodium carbonates, the common mineral acids, and of methyl and ethyl alcohols, glycerin, and dextrose, with the corresponding values, in certain cases on the hydrometers in common use.

The book is conveniently arranged, and will be found useful for purposes of reference by analytical and physiological chemists.

THE WORLD'S WHEAT SUPPLY.

The Wheat Problem. By Sir William Crookes. Third edition. With Preface and additional chapter bringing the Statistical Information up to date, and a chapter on Future Wheat Supplies, by Sir R. H. Rew. With an Introduction by Lord Rhondda. Pp. xvi+100. (London: Longmans, Green, and Co., 1917.) Price 3*s.* 6*d.* net.

IT is now nearly twenty years since Sir William Crookes discussed the world's wheat supply in his presidential address to the Bristol meeting of the British Association in 1898. His address, issued afterwards in book form, has already passed through two editions. This third and revised edition, for the publication of which Lord Rhondda appears to be responsible, could not have appeared at a more opportune moment. No one at the present time can fail to appreciate the gravity of the problem which the author presents. The recent enactment of the Corn Production Bill shows that even politicians recognise its urgency and have taken steps to secure the production of a greater area of wheat.

But it is not to legislative aid that Sir William Crookes trusts for increased corn production. His hope—to quote his own words—is that "starvation may be averted through the laboratory." The argument is briefly as follows:—

A large and progressively increasing proportion of the world's inhabitants feed upon wheat, and the world's demand for wheat continuously increases. The possibility of increasing wheat production by extension of area is shown to be approaching finality. The time must, therefore, arrive in the near future when the world's wheat production will not meet the world's demand, and famine must necessarily follow. This can be averted only by increasing the yield of wheat per acre, which can be most readily achieved by the increased use of nitrogenous manures.

But the world's requirements for nitrogenous manures for this purpose would rapidly exhaust all possible existing supplies—sulphate of ammonia, nitrate of soda, and guano. It is claimed that the fixation of atmospheric nitrogen by a chemical process provides the only practical safeguard against a rapidly approaching world's wheat shortage.

It is further stated that the fixation of atmospheric nitrogen on a commercial scale is a practicable proposition, for its development has pro-

vided combined nitrogen for manure and explosives in sufficient amounts to enable Germany to continue the war.

A last chapter, written for this edition by Sir Henry Rew, gives a somewhat more optimistic forecast, based on more recent and detailed statistics, of the possibility of extending the world's wheat supply without the introduction of any new factor, such as cheap nitrogenous manure made from the atmosphere.

Of the vital interest and importance of the problem at the present time there can be no two opinions. The book should be read by everyone. For some years the world's wheat crop has barely sufficed for the world's consumption. With the restriction of labour, manures, etc., by the war, a world's wheat shortage may confidently be expected. What this would mean to us is shown by the fact that wheat provides more than 30 per cent. of the energy of the national food budget, and as much as 60 per cent. in certain classes. Every possible effort should, therefore, be made to increase wheat production.

The Corn Production Act will no doubt increase the area. To increase the crop per acre is, as Sir William Crookes suggests, a problem for the laboratory. But there are many possibilities beyond the synthesis of cheap nitrogenous manures. In the first place, the amount of farmyard manure produced annually in the United Kingdom is probably not far from 50 million tons, containing about 250,000 tons of nitrogen. Half of this is certainly lost through the imperfect methods of making and storing in common use. If the loss could be reduced by only 10 per cent. the saving of nitrogen would be equivalent to a normal dressing of sulphate of ammonia over the whole wheat area of the United Kingdom.

But manurial nitrogen is by no means the only factor which limits wheat production. It has been estimated that fungoid diseases on the average depress the world's wheat crop by about 30 per cent. Biffen's work on the inheritance of immunity to rust has opened the door for improvement in this direction. Experience gained with the first rust-immune variety to get into general cultivation—"Little Joss"—suggests that immunity to rust in this country is able to increase the yield by about 10 per cent. In other countries immunity to other diseases would probably be still more effective.

Beaven has shown, too, that even when the total crop is limited it is possible to select varieties which give an abnormally high proportion of grain to straw. This method of selection, which has so far been applied only to barley, appears likely to increase grain production by at least 10 per cent. without increasing the drain upon the soil.

Notwithstanding these and possibly other factors which may increase yield per acre, there is no doubt that in the main a cheap and plentiful supply of nitrogenous manure, combined with the spread of knowledge as to its proper use, would do more than anything else to increase the world's wheat production. With this in mind perhaps it is not too much to hope that Lord Rhondda will use his power as capitalist and organiser to ensure that the fixation of atmospheric nitrogen shall have a fair chance of succeeding both commercially and scientifically.

T. B. W.

THE PROBLEM OF HUMAN INSTINCT.

(1) *The Psychology of War.* By Dr. John T. MacCurdy. Pp. xi+68. (London: William Heinemann, 1917.) Price 2s. 6d. net.

(2) *Instinct in Man: A Contribution to the Psychology of Education.* By Dr. J. Drever. Pp. x+281. (Cambridge: At the University Press, 1917.) Price 9s. net.

THE study of instinct as a factor in human nature is a modern, even a contemporary, development. The philosophers of the seventeenth and eighteenth centuries wrote much about the passions and the inclinations and the appetites, by which they meant the irrational impulses which form the baser animal nature, upon which, as they thought, the rational nature is superposed as a spiritual endowment. The modern treatment of the problem, however, is the outcome of the enormous advance of the biological sciences in the latter half of the nineteenth century in the work of Darwin and his successors. Particular attention is being focussed on the study to-day. The great world-war, with the deliberate destruction of accumulated wealth on a gigantic scale, and the devotion to death and mutilation of a whole generation, is so manifestly irrational that we are driven, perforce, to seek the meaning and cause of war in instinct as opposed to reason, in a primitive nature consisting of impulses and cravings imperfectly controlled by intellect.

(1) The two books before us deal with this problem of instinct in man from very different points of view. The small book of Dr. MacCurdy is of the nature of an exhortation called forth by the special circumstances of the day. The idea that underlies it is that there is a striking analogy between abnormal psychology, which reveals the havoc wrought in the individual mind by the loss of control over repressed complexes, and the psychology of nations at war. The suggestion is that there may be a psychiatry for social, as there is for individual, disintegration of personality.

(2) Dr. Drever's main interest is the application of the theory of human instinct to educational theory and practice. The modern problem of instinct is threefold—philosophical, psychological, and biological. The philosophical problem concerns the cognitive aspect of instinct, and centres round the theory of Bergson. Instinct, in Bergson's view, is a mode of knowing, intuitive in character, different in kind, and divergent in orientation from the mode of knowing which we name intelligence. Dr. Drever, without definitely rejecting this view, thinks that the problem can be solved by the adoption of a very simple formula. This is that instinct is knowledge at the perceptual level, intelligence being conceptual. But, useful as such a distinction may be for provisional

description, it will carry us only a very little way towards a solution of the problem. No one, indeed, who has learnt the lesson of Kant can imagine that percepts devoid of concepts satisfy the conditions which make experience possible.

The psychological problem of human instinct emphasises the affective rather than the cognitive aspect. Its inception was McDougall's theory in "Social Psychology." The human instincts in this view are innate dispositions to act under definite stimulation. They are distinct, and may be enumerated, but each primary instinct is correlated with a specific emotion. This relation of the instinct to a specific emotion was challenged by Shand in "The Foundations of Character." Dr. Drever puts forward an interesting theory of emotion, which deserves particular notice. Emotion he holds to be the "tension" due to the checking of an impulse.

The biological problem of instinct lays stress on the conative aspect, and is mainly a genetic, as opposed to an analytic, study. It is the genetic problem which is emphasised in the experimental work of Lloyd Morgan. Dr. Drever expounds the view that the essential phenomenon in instinctive behaviour is "primary meaning," which in experience acquires "significance." This at once indicates the practical relation of theory of instinct to education.

H. W. C.

OUR BOOKSHELF.

The Fishing Village and Other Writings (Literary and Scientific). By W. Omer-Cooper. Introduction by George A. B. Dewar. (Bournemouth: Horace G. Commin, 1917.) Price 3*s*. 6*d*. net.

THIS little volume, from the patriotic point of view, records the ready and eager devotion of a young life, the self-sacrifice so nobly shared with thousands of other men, including even actual boys. To a scientific journal its appeal is different. Though falling in battle before he was twenty-two, Wilfrid Omer-Cooper had already made his mark as a naturalist by ardour in research, acuteness in observing, and a highly useful facility of expression. Evidence of this zeal and capacity led to his becoming a fellow of the Linnean Society at the earliest possible date, as was the case with Sir William Hooker and his son, Sir Joseph Hooker, though with how different a tenure, one of fewer weeks than they had years.

The general reader can scarcely fail to be moved by the quaintness of Mr. Omer-Cooper's almost lover-like letters to his mother, who in earlier years may well have felt no little anxiety from her son's George-Borrow-like fondness for visiting gipsy encampments.

The chapters on lizards and serpents are of popular interest without giving scope for any special originality. It is among marine invertebrates and terrestrial isopods that the young naturalist found an opening for advancing research and encouraging scientific pursuits. In regard to the latter group the name of Alexander Patience should have been included in the list of recent authorities. There is rather too sharp a touch in the notice of "The British Woodlice," by Webb and Sillem, since scarcely any compendious work on any subject is free from "inaccuracies." Even in this small volume slugs are referred to as insects (p. 118); the generic name Metoponorthus is used instead of Porcellionides (p. 141), and the genus Paragnathia, instituted in the *Zoologist* for January, 1916, by the author and his brother Joseph, is referred in consecutive lines to two different families (p. 153). The strange differences in the sexes of the Gnathiidæ are well described, and altogether "The Fishing Village," with its youthful poetry, solemn philosophy, well-considered science, and other features, makes a very readable book.

Cape Peninsula List of Serials. Second edition. Pp. 95+iv. (Cape Town: Printed for the Trustees of the South African Public Library, 1917.)

THIS is a list of about 1300 scientific periodicals which are available for reference to readers in the Cape of Good Hope, the special feature being the indication of the library or libraries in which each periodical may be found.

The compilation has been made by Mr. A. C. G. Lloyd, who has had the advice and assistance of Sir Thomas Muir and Mr. Pilling.

A notice of the first edition of this useful index appeared in NATURE in 1912 (vol. xc., p. 434). The work was then printed in seven columns, the first column giving the name of the periodical, the remaining columns being allotted to the libraries indexed.

In the new edition great care has been taken, in dealing with incomplete sets, not only to state that the set or volume is incomplete, but to give detailed lists of the missing parts. The space required for these details has been obtained by giving up the arrangement in parallel columns. These exact details as to missing parts and volumes will no doubt induce the authorities of the libraries in which they occur to take steps to fill the gaps wherever that is possible. Indeed, it is stated that since the publication of the first edition of this list of serials gaps in thirty-one sets have been wholly or partially filled up.

Lists of serials which enable the scientific worker to ascertain where a particular volume can be consulted are always welcome. In the present case consultation is made very easy by the simple arrangement of the material.

Chemistry for Beginners and Schoolboys. By C. T. Kingzett. Second edition. Pp. viii+150. (London: Baillière, Tindall, and Cox, 1918.) Price 2*s*. 6*d*. net.

THE first edition of Mr. Kingzett's little book was reviewed in our issue of July 26 last (vol. xcix., p. 422). It is sufficient to say of the present edition that some rearrangement of matter has been made, and the book has been carefully revised and considerably enlarged by the incorporation of some additional information.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The East and West Asymmetry of Solar Prominences.

IT has attracted the attention of astronomers for some time that solar prominences appear to be more numerous on the east, or advancing, side of the sun than on the west, or receding, side, and systematic observations have been instituted to test this unexpected result. The current Kodaikanal Bulletin (lvii., August, 1917) seems to establish it definitely by a very complete analysis of the observations for the first half of 1917. Of prominences projected on the solar disc as absorption markings, 52·9 per cent. as regards area, and 53·4 per cent. as regards number, were on the eastern side of the central meridian. Of reversals and displacements (largely preponderant towards the red) of hydrogen lines on the disc, there was a like excess on the eastern side. But of the bright prominences directly observed on the limb there was no excess as regards number, and only a slight excess as regards area.

The solar disturbances must presumably be uniformly distributed all round the sun's equator; it would seem to be extremely unlikely, as is generally recognised, that the side which happens to be presented to the earth or any other planet should exhibit special features. But it has doubtless not been overlooked that a more probable mode of explanation is open. Although the character of the prominences can scarcely be affected by any influence of the earth, yet their appearance may be considerably affected by their own configuration with respect to the line of sight of the observer. The outer regions of the solar atmosphere are rotating more rapidly than the parts below; if then a prominence pushed up from below into the atmosphere sloped forwards in the direction of the sun's rotation instead of being on the average perpendicular to the surface, it would present a different aspect and different depth in the line of sight to the observer, according as it is on the advancing or receding side of the sun. The darkness of the absorption markings on the disc would depend on the depth of material through which the light had to penetrate to the observer, and perhaps also in consequence the number of shadings that would be counted as markings would be affected. The amount and direction of this influence it may be hazardous to guess at, but it might just be possible to detect some slight difference in the general appearance of the markings east and west. To the bright prominences on the limb these considerations would apply in a smaller degree, if at all. J. L.

Cambridge, January 26.

Carnotite Ores and the Supply of Radium.

IN NATURE for October 25, 1917, there appeared a review of Dr. P. E. Browning's book, "Introduction to the Rarer Elements." A special chapter devoted to the radio-elements was contributed by me, and in commenting on this section the reviewer takes exception to a statement that "the chief source of radium has been the minerals containing a higher proportion of uranium, principally carnotite, and the present supply has been largely obtained from the carnotite ores of south-western Colorado." Since the comments of the reviewer suggest the possibility of an even more widespread misconception of the true conditions, I am taking the liberty of mentioning some of the facts upon which the above statement is based.

The *minerals* containing a *higher* proportion of uranium are the several varieties of uraninite (including pitchblende, cleveite, thorianite, etc.), autunite, carnotite, gummite, uranophane, and a number of others which occur only in comparatively small quantities. The *ores* of uranium from which the supply of radium in commerce has been obtained consist of mixtures of relatively small proportions of these minerals with large proportions of valueless mineral matter, chiefly silica. Thus in the carnotite ores from Colorado the uranium mineral constituent is carnotite containing sometimes as much as 55 per cent. of uranium, while the actual content of uranium in the *ore* is in most cases scarcely more than 2 per cent. Carefully selected specimens of pitchblende from St. Joachimsthal may occasionally run as high as 70 per cent. uranium, but the *ores* from this mine, even after concentration, seldom contain more than about 10 per cent. of uranium. Although no trustworthy information on this topic has ever, to my knowledge, been made public, I am strongly inclined to the opinion that the average Cornwall ores (containing pitchblende as the chief uranium mineral constituent) seldom contain more than 5 per cent. of uranium, and I have direct knowledge that some shipments from this locality have fallen considerably below this figure. Other examples might be given, but the above will suffice to justify the statement that "the chief source of radium has been the *minerals* containing a higher proportion of uranium." It is clear that the uranium content of the *ore* is seldom indicative of the proportion of uranium contained in the uranium mineral which carries the radium.

In regard to the proportion of the world's supply of radium salts contributed by the Colorado carnotite ores, I may perhaps state that the greater proportion of the radium salts furnished during the years 1903–12 by the De Haen Company, of Hanover, and the Brunswick Quinine Factory was extracted from these ores. The chief source of the radium prepared by the Armet de Lisle and other French factories has been the Colorado ores, and large shipments have also been made to Great Britain from this country. The National Radium Institute and the Standard Chemical Company have separated relatively large amounts of radium salts from the Colorado carnotite ores exclusively. It has been conservatively estimated by those familiar with the subject that prior to 1913 at least one-half of the world's supply of radium salts had been extracted from Colorado carnotite, and the proportion supplied by the Colorado ores since that year has been very much larger. Additional information can be obtained by those who desire it from the publications of the U.S. Bureau of Mines (*not* Bureau of Standards), the special papers of Dr. C. L. Parsons, chief of the Division of Mineral Technology, U.S. Bureau of Mines, and the records of the "Hearing on Radium" before the U.S. Senate and House of Representatives (Public Documents, S. 4405, and H. J. Res. 185 and 186).

BERTRAM B. BOLTWOOD.

Yale University, New Haven, Conn., U.S.A., November 30.

I AM afraid that Prof. Boltwood does not quite see the reason why I hesitated to endorse the statement in question: it was necessary to quote the whole paragraph as it appears in the article, but my difficulty was confined to the words "principally carnotite." It is, of course, obvious that the chief source of radium is the minerals containing a higher percentage of uranium, and it was for that reason only that I hesi-

tated to place carnotite, which at most carries 60 per cent. of uranium, before the pure uranium mineral pitchblende, of which considerable deposits are known to exist both at St. Joachimsthal and in Cornwall, as well as in other countries.

Doubtless the bulk of the present supply of radium has been won from Colorado carnotite ores, but the discovery of radium, all the pioneer work on its separation, and the whole of our first supplies of the salts came from pitchblende. When the present abnormal conditions due to the war have passed, work upon uraninite, both in Bohemia and Cornwall, now practically suspended, will probably become considerable.

J. H. GARDINER.

The Growth of Conifers.

MY friend, Mr. D. M. Andrews, has communicated to me an observation which seems to deserve comment. At the Government nursery near Monument, Colorado, at an altitude of 7000 ft., there are two beds of two-year-old seedlings of Engelmann spruce (*Picea Engelmanni*), a common tree of the Rocky Mountains. Each lot is shown to be hardy in the locality, having passed a winter in the open, protected only by a covering of oak branches. The seedlings in one bed, raised from seed gathered in the Pike's Peak, Colorado, region, were, when examined, about 2½ in. high, and had matured their buds and ceased growing for the year in the latter part of August. The seedlings in the other bed, from Arizona seed planted at the same time, were about 4 in. high, and had not yet completed their growth for the year. The Arizona seedlings were green, those from Colorado strongly bluish. Seeking an explanation for this difference, it appears probable that the Colorado trees became adapted to a more severe climate during the waning of the last glacial period, and have not yet lost the physiological characters appropriate to past conditions. The Arizona trees, the ancestors of which lived in a milder, more southern region, did not develop such adaptations, and now that our climate has changed they are actually better fitted for Colorado conditions than trees of Colorado ancestry.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado,
December 29, 1917.

THE OUTLOOK IN FRENCH AGRICULTURE.

THE *Revue Scientifique* for September 22 contains a report on the position and prospects of French agriculture presented by M. Louis Mangin, of the Académie des Sciences, to the National Council of the Ligue Française on behalf of the Committee on Economic Organisation of that body. The position revealed is far from reassuring. Wheat production has fallen to barely 70 per cent. of the prewar crop, potatoes to 80 per cent., wine to 65 per cent., and sugar-beet to little more than 30 per cent. The situation as regards live stock shows the same disquieting features. Practically 20 per cent. of the pre-war head of cattle fell into the hands of the enemy, and ill-devised measures taken to secure the meat supply in the early days of the war further seriously accentuated the shrinkage. Although the cattle position from the point of view of numbers has since been substantially improved, the proportion of young stock is so great that substantial relief of the meat stringency cannot be expected from home resources for a considerable time. The decline in numbers of sheep which had set in long before the war has been greatly accentuated. Pigs also show a decline of 38 per cent. since the end of 1913. No reference is made to the position as regards milk production. A survey of the forest area completes the tale of depleted resources, something like one-eighth of this area having been already denuded, with but little provision for its replacement.

Many suggestions are put forward for the relief of the present situation and for the future restoration and strengthening of French agriculture. The claims of rice as a diluent of wheaten flour are strongly urged in view of the large supplies available in the Asiatic colonies. To overcome the difficulties of shortage of manual labour on the land, the organisation of supplies of African and yellow labour is suggested, whilst further relief could be obtained by a more active policy with reference to the production and use of motor tractors and farm machinery in general. The example of England in placing this manufacture under the same control as that of munitions of war is warmly commended. Consolidation of estates is urgently necessary and should be accompanied by a revision of the register of lands. The price of corn should be left sufficiently free to rise to encourage production, whilst at the same time the rise in the price of bread should be restricted by all appropriate means. It is suggested that these two apparently irreconcilable objects can be effectively attained through the establishment of municipal bread bureaux, which should subsidise or tax the bakers according to the fluctuations in the price of corn. This expedient was successfully resorted to during the Crimean War.

It is urged that the home production of manures should be fostered by using every measure to increase the output of sulphate of ammonia, by developing the synthetic manufacture of nitrates and ammonia from the atmosphere, and by increasing the production of superphosphate, all of which industries, it is urged, should have the same privileges as munition factories. To secure increased crops arrangements should be made for free distribution of manures to small cultivators.

Measures must be taken for restoring the head of live stock. To this end restrictions must be placed upon slaughter of home stock; the colonial resources of Madagascar and Africa must be drawn upon for meat, to be prepared there in frozen or otherwise preserved condition in order to reduce costs of transport. For the same reason abattoirs and refrigerating plants should be established in the home meat-producing districts, whereby cheaper production and reduction in the number of middlemen would be secured. The strong prejudice of the people against refrigerated or preserved meat must be broken down, and much could be done in this direction by the use of such products throughout the Army and Navy.

SIR JOHN WOLFE BARRY, K.C.B., F.R.S.

SIR JOHN WOLFE BARRY, the eminent civil engineer, died on January 22, in his eighty-second year. The youngest son of Sir Charles Barry, R.A., the architect of the Houses of Parliament, he was educated at Trinity College, Glenalmond, and at King's College, London. He was a pupil of Sir John Hawkshaw, and afterwards for him assistant resident engineer on the Charing Cross and Cannon Street Railway. In 1867 he started in private practice.

Sir John Wolfe Barry devoted himself largely to the construction of bridges, railways, and docks, and by his ability, wide experience, and energy acquired a position of leadership in the engineering profession. He gave ungrudging assistance to all public undertakings and inquiries involving engineering considerations, and had great influence in many ways in promoting the industrial and commercial prosperity of the country. He took great interest in efforts to raise the scientific qualifications of engineers and in the investigation of engineering problems. A member of the Institution of Civil Engineers for fifty years, on its council for thirty-four years, and its president in 1896–97, his authority and the value of his services to it can scarcely be overrated. He became F.R.S. in 1895, K.C.B. in 1897, and was chairman of council of the Royal Society of Arts in 1898–99.

There is not space here to enumerate the numerous undertakings on which Sir John Wolfe Barry was engaged in an executive or consultative capacity. Amongst them were the Lewes and East Grinstead Railway, the Inner Circle extension from the Mansion House to Whitechapel—a work of great difficulty—the Blackfriars arched railway bridge, the Tower Bridge (in association with the late Sir Horace Jones), the King Edward VII. Bridge at Kew, the Barry docks and railways, the Grangemouth dock, and the entrance lock and graving dock at Immingham; also dock and railway works in Buenos Ayres, Natal, and India. Sir John took an interest in the introduction of electricity on railways. With the late Sir Charles Hartley, he represented this country on the Suez Canal International Commission; with Sir E. Fry and Sir Hugh Owen, he was a member of the Court of Arbitration for the purchase of the London Water Companies, and was a member of the Royal Commission on London Traffic in 1903–5.

Perhaps the greatest service rendered by Sir John Wolfe Barry to engineering industries was the part he took in founding and directing the activities of the Engineering Standards Committee. It was due mainly to his insight and influence that representatives of Government departments, engineers, manufacturers, shipbuilders, and others were brought together, and have freely given their time and experience in dealing with the complex details of standardisation, a work of the greatest national importance. Sir John, in 1917, gave an account of the work of the Standards Committee, during sixteen years, in a lecture to the Institution of Civil Engineers on "The Standardisation of Engineering Materials and its Influence on the Prosperity of the Country." Started in a tentative way, with the object of reducing the wholly unnecessary number of rolled sections of steel bars and rails, produced by manufacturers who had to meet the wishes of different engineers and architects, it was soon found necessary to draw up complete specifications of quality and of the tests to which material should be subjected. The work of the committee then extended to other departments of industry, especially to the various branches of the electrical industry. The main committee now consists of twenty-two members, and there are sixty-four sectional and sub-committees, having in the aggregate more than 500 members. Practically all persons interested are represented and have a consultative voice in all proposals for standardisation. The specifications adopted are published, and when necessary revised annually.

Sir John Wolfe Barry pointed out in his lecture that it was difficult to estimate exactly the beneficial results of standardisation, but that he was justified in saying that they have been immense in facilitating production and in cheapening output, while ensuring excellence in the scientific composition of materials and in accuracy of workmanship. Thus, in the case of Portland cement, whereas formerly different specifications were imposed by different users, involving modifications in manufacture, practically now the whole output is made to one standard specification.

In the case of rolled sections for construction, for shipbuilding, and for railway and tramway rails, the annual output before the war was 3,700,000 tons, valued at 25,000,000*l*. Of this at least 85 per cent., and in some cases 95 per cent., were rolled to standard specifications.

The war has raised serious problems as to the security in the future of our foreign trade. Under Sir John Wolfe Barry's guidance, the Standards Committee has undertaken the laborious work of translating the standard specifications into French, Spanish, and Russian, converting British into metric measures, and issuing them in a much cheaper form. It also contemplates the establishment, in twelve important foreign trading centres, of local committees in touch with the London organisation, and concerned with the promotion of trade.

Sir John took an active interest in the foundation of the National Physical Laboratory, having been a member of its Executive Committee, and greatly assisted it in obtaining such funds as it has secured for carrying on its work and in making it the expert authority in scientific questions arising in connection with standardisation. He exerted great influence in the improvement of technical education. He was chairman of the Executive Committee of the City and Guilds of London Institute, and took much interest in the development of the Central Technical College. Since the reorganisation of the London University, he was

for a time a member of the Senate, and up to the date of his death was chairman of the delegacy which governs the City and Guilds Engineering College. It was at his instance that the Institution of Civil Engineers adopted an examination scheme so that candidates for admission to membership must now pass an educational test as well as an investigation of their experience in constructional work.

At the memorial service held at St. Margaret's Church, Westminster, on Saturday, January 26, there were present, in a large and distinguished congregation, representatives of many scientific societies and other bodies with which Sir J. Wolfe Barry was connected, including the following:—British Science Guild (Sir Robert Hadfield and Sir Alex. Pedler); City and Guilds Engineering College (Profs. W. E. Dalby, A. R. Forsyth, and T. Mather); Imperial College of Science and Technology (Sir Alfred Keogh and Mr. Alexander Gow); Institute of Municipal and County Engineers (Mr. Thomas Cole); Institution of Civil Engineers (Mr. Harry Jones and Dr. J. H. T. Tudsbery); Institution of Electrical Engineers (Mr. R. Elliott-Cooper and Mr. Alexander Ross); Institution of Naval Architects (Sir Henry J. Oram and Mr. Robert W. Dana); King's College, London (Mr. W. Smith); National Physical Laboratory (Sir Richard Glazebrook); Royal Institution (Sir W. Phipson Beale and Hon. R. C. Parsons); Royal Society (Sir J. J. Thomson and Sir Richard Glazebrook); Royal Society of Arts (Mr. A. A. Campbell Swinton and Mr. G. K. Menzies); and Surveyors' Institution (Mr. Alexander Goddard).

DR. WILLIAM GREENWELL, F.R.S.

THE distinguished archæologist, Dr. William Greenwell, of Durham, died on January 27 in his ninety-eighth year. He was affectionately referred to by everybody as Canon Greenwell, on the strength of a minor canonry of Durham, which was the highest promotion the Church found for him, and which he adorned for more than sixty years. For all that time he was the guide, philosopher, and friend of two generations of archæologists. What he was to the Church in Durham may be indicated by his preservation of the windows of Lanchester Church and by other work in ecclesiastical antiquity.

Dr. Greenwell became the local secretary for Durham of the Society of Antiquaries in 1866, and was elected a fellow in 1868. He did not attend to be admitted until 1875, but in the meantime made several communications to the society. His contributions to *Archaeologia* were six, made between 1889 and 1909. The majority of the papers read and exhibits made by him to the society during his fifty-two years' association with it related to prehistoric archæology, on which he wrote with high authority; but he was equally at home in describing a ring of Alfred the Great's sister, which he had added to his collections, or a portrait of Mary Tudor, belonging to the Dean and Chapter. He was an indefatigable explorer and a discriminating collector. Before 1880 he accumulated objects from 234 barrows, and these he presented to the British Museum. No sooner had he given away or sold one collection than he began to make another. This happened more than once. The latest instance is that of the fine collection of remains of the Bronze age which was acquired for the British Museum a few years ago by the munificence of a lamented American millionaire. We are much mistaken if, since then, another collection has not been well begun. He lectured at the Royal Institution in 1867 on the Yorkshire barrows.

Dr. Greenwell joined the Ethnological Society in 1868, was forthwith elected on its council, and contributed to it in 1870 an account of the opening of Grimes Graves near Brandon, in Norfolk. He was elected a fellow of the Royal Society in 1878. He addressed the Royal Archæological Institute at Durham in 1908 with "extraordinary knowledge and lucidity" on the development of the spear and dagger during the Bronze age.

Of his published works, besides his papers in the Transactions of these and many other societies, and several ancient records edited by him for the Surtees Society, the principal is that on British barrows, in which the late Prof. Rolleston collaborated.

Dr. Greenwell was honorary D.C.L. of Durham, a man of versatile accomplishments and much learning. He was an adept in the sport of fly-fishing, which he practised almost to the last. Genial and witty, warm-hearted and enthusiastic, he lived every day of his long life.

MISS ETHEL SARGANT.

BY the death of Miss Ethel Sargant, which occurred on January 16, after a brief illness, at the age of fifty-four, botanical science has sustained a severe loss. Miss Sargant was educated at the North London Collegiate School and at Girton College, Cambridge; she took the two parts of the Natural Sciences Tripos in 1884 and 1885. In 1913 she was elected to an honorary fellowship of Girton College. She was a fellow of the Linnean Society, and was the first woman to serve on its council. At the time of her death she was president of the Federation of University Women.

Miss Sargant spent a year at Kew (1892–93), working at the Jodrell Laboratory under Dr. D. H. Scott; she always spoke with gratitude and enthusiasm of the training in the methods and spirit of research which she received at his hands. A paper written in collaboration with Dr. Scott appeared in the *Annals of Botany* in 1893. All Miss Sargant's later research was carried out privately, for some years in a laboratory built in the grounds of her mother's house at Reigate, and eventually at her own home in Girton village, Cambridge. Her earlier work, after leaving Kew, was cytological, and dealt with the formation of the sexual nuclei in *Lilium martagon*. Her attention to the structure of the embryo-sac bore further fruit at a later date in an interesting theory regarding the meaning of "double fertilisation" in Angiosperms, which she developed in the *Annals of Botany* for 1900.

But Miss Sargant's principal work lay in the direction of anatomy and morphology: she possessed the "morphological sense" to a most remarkable degree, and the anatomy of seedlings became a subject which she made peculiarly her own. She formed a unique collection of microscopical preparations illustrating the vascular anatomy of monocotyledonous seedlings. She was the first botanist to apply microtome technique to the elucidation of the problems presented by the anatomical transition from stem to root; owing to the extreme shortness of the hypocotyl in many monocotyledonous seedlings, it is often quite impossible to demonstrate their structure by means of hand sections alone. In a series of papers, the great majority of which appeared in the *Annals of Botany,* she developed her well-known theory of the origin of monocotyledons, based upon the results of her researches into seedling structure. In 1913 she was president of Section K (Botany) at the Birmingham meeting of the British Association, being the first woman chosen to preside over a section. She took for the subject of her address "The Development of Botanical Embryology since 1870," and gave a masterly review of a difficult and controversial field, in which she had herself broken much new ground.

NOTES.

THE gold medal of the Royal Astronomical Society has been awarded by the council of the society to Mr. John Evershed for his investigations of radial motion in sun-spots and other contributions to astrophysics. The Hannah Jackson (*née* Gwilt) gift has been awarded to the Rev. T. E. R. Phillips for his observations of planets, double stars, and variable stars. The awards will be presented at the annual general meeting to be held on Friday, February 8.

THE scheme for the reconstitution of the Labour Party, to which we referred last week (p. 404), providing for representation of producers "by brain" as well as "by hand," was submitted by Mr. Henderson on behalf of the executive to the conference at Nottingham on January 23. After discussion it was decided that the draft scheme should be referred to the affiliated societies, and that another conference should be called in a month's time to consider it.

THE proposed formation of a British Association of Chemists will be discussed at the meeting of the London Section of the Society of Chemical Industry to be held at the Royal Society of Arts on Monday, February 4, at 7.30 p.m.

THE death has occurred, in his sixty-seventh year, of Mr. Louis P. Gratacap, curator in mineralogy in the American Museum of Natural History since 1900. For the previous nine years he had held the post of assistant curator. His publications included a standard "Guide to Mineral Collections," "Popular Mineralogy," and "Geology of the City of New York."

THE death is announced, at the early age of forty-five, of Dr. T. C. Janeway, who occupied, at Johns Hopkins University, the chair of medicine formerly filled by Sir William Osler. He was a member of the Board of Scientific Directors of the Rockefeller Institute for Medical Research, and secretary of the Russell Sage Institute of Pathology. Prof. Janeway was the author of "The Clinical Study of Blood Pressure."

THE Research Defence Society and the Association for the Advancement of Medicine by Research have been united into one society, which will retain the name and official address of the Research Defence Society. All such communications as used to be made to the association should, therefore, now be made to the honorary secretary of the Research Defence Society, 21 Ladbroke Square, London, W.11.

IN consequence of a statement from F. I. Faltz-Fein directing attention to the dangers which, in the present circumstances, threaten the existence of the famous zoological park and horse-breeding station on his estate at Ascania Nova, the council of the All-Russian Horse-breeders' Congress brought the matter to the notice of the Petrograd Academy of Sciences, with the earnest request that immediate and energetic measures be taken for the protection of an establishment which is of very great scientific value, and justly considered the pride of Russia. It is announced in the December Bulletin of the Academy that, in response to this appeal, the Government has instructed Maj.-Gen. P. K. Kozlov to take the necessary measures.

ACCORDING to reports in the French Press, a "General Congress of Civil Engineering" will be held in Paris on March 18–23 next. The objects of the conference, as recently explained to the French Minister of Commerce and Industry, are to awaken the French nation to the need for increased industrial enterprise and the attainment of industrial agreement. The Minister expressed the hope that the conference would give very close attention to such questions as the saving of fuel and the thorough utilisation of intellectual and mechanical effort; wage war on waste of all kinds; and advocate the systematic utilisation of by-products, and the adoption of improved scientific mechanical methods of production—in short, give that place to applied knowledge that it now merits.

THE Minister of Reconstruction has appointed the following committee of manufacturers and business men to consider the provision of new industries for the engineering trades:—The Hon. H. D. McLaren (chairman), Mr. C. Bennion, Sir George Bullough, Bart., Mr. F. H. Crittall, Mr. R. Dumas, Mr. W. B. Lang, Mr. C. A. Lister, Mr. P. J. Pybus, Mr. G. H. Sankey, Sir Percy Stothert, Mr. J. Taylor, Mr. W. Taylor, Mr. W. Thom, and Sir W. Rowan Thomson. The duties of the new committee will be to compile a list of the articles suitable for manufacture by British engineers which were either not made in the United Kingdom or made in insufficient quantities, and for which there is likely to be a demand after the war. The need for such a list of articles and for some organised effort to make them at home has been amply shown by the war, which has revealed our dependence on many—even the enemy—countries for articles vital to our industries, and even to our war equipment.

BY the death of Lieut. E. J. Woodhouse in France on December 18 last, from wounds received early in the month, the Indian Agricultural Service has lost a capable organiser and adviser. Educated at Marlborough, Lieut. Woodhouse entered Trinity College, Cambridge, in 1903. In 1906 he graduated with honours in the Natural Sciences Tripos, and the following year obtained the University diploma in agriculture. He then proceeded to India to take up the post of economic botanist to the Government of Bengal. Three years later he was appointed principal of the Agricultural

College of Bihar and Orissa, but still retained his post as economic botanist. His chief work was on problems connected with economic botany, but he also undertook some work on economic entomology, and successfully demonstrated a method of reducing the attacks of surface caterpillars on a very large scale and of reducing the attacks of potato moths in Bengal. At the outbreak of the war he was a captain in the Bihar Light Horse, and in February, 1915, joined the Indian Army Reserve of Officers. In July of that year he went to France, where he carried on with his usual energy. Lieut. Woodhouse was a capable worker, and won the good opinion of all who came in contact with him.

It is with regret that we have to record the passing of another veteran from the ranks of the great engineers of the Victorian era. Sir Alexander Meadows Rendel has just died at the ripe age of eighty-eight. His death recalls the construction, rather more than sixty years ago, of the Royal Victoria Dock and of the Shadwell Basin, London Docks, when he acted as engineer to the London Dock Company. Sir Alexander had then just succeeded to the practice of his father, Mr. James M. Rendel, F.R.S. The family was, in fact, devoted to engineering work, both by tradition and natural inclination. All four of Mr. Rendel's sons attained distinction and repute, three of them, including Lord Rendel, in connection with the great firm at Elswick, of which Lord Armstrong was the head. It was fitting, therefore, and almost inevitable, that, on the completion of his academic training at Cambridge, where he was a scholar of Trinity, the eldest son should pass into the office of his father. In addition to the docks mentioned above, Sir Alexander was responsible for the Albert and Edinburgh Docks at Leith. But it is principally in connection with India that his name will be remembered. He was consulting engineer to the India Office and to many of the Indian railway companies. He designed and constructed a very large number of bridges, of which the most important were the Lansdowne Bridge over the Indus at Sukkur, opened in 1889, and the Hardinge Bridge, over the Ganges at Sara, completed in 1915. He paid a number of visits to India, and so close was his association with Indian affairs that it is not too much to say that over a period dating from days before the Indian Mutiny he exercised a very considerable influence, not only in strictly engineering matters, but on the general policy and administration of the Indian railway system.

The death, about three months ago, of Dr. Maryan Smoluchowski de Smolan, professor of physics at the University of Cracow, Poland, at forty-five years of age, deprives the scientific world of a pioneer in the field of modern thermodynamics and the kinetic theory of matter. Smoluchowski's chief investigations, already crowned with notable success and full of promise for the future, centred round the problems of the so-called fluctuations about the average, normal state of statistical equilibrium. The most prominent example of his researches of this kind is his famous explanation of the opalescence of gases at or near the critical state. Most of Smoluchowski's papers were published in the Transactions and the Bulletin of the Academy of Sciences of Cracow. A good summary of his own work and of the problems that most interested him will be found in his report in the *Physikalische Zeitschrift*, vol. xiii. (1912), p. 1069. The non-specialist will find an easily accessible description of some of his researches in Perrin's attractive book "Les Atomes." Smoluchowski's scientific attitude and tendencies, however, are best characterised in his address given at the University of Göttingen, "On the Limits of Validity of the Second Law of Heat Theory" (*cf.* "Vorträge üb. d. kinet. Theorie d. Materie u. d. Elektrizität von Planck, Debye, Nernst, Smoluchowski, Sommerfeld u. Lorentz"; Leipzig: Teubner, 1914, pp. 89–121). This admirable lecture will be found to contain not only a clear explanation of the famous difficulties connected with Boltzmann's H-theorem, but also a fascinating description of the *rôle* of fluctuations as restrictors of the validity of the second law of thermodynamics, increasing at the same time the true value of that law, and presenting it in an interesting light.

Very soon after the commencement of the war the Government of this country was made to realise that the services of chemists, as distinguished from pharmacists, are really of essential national importance. The special position as regards recruiting for the Army, into which chemists of high qualification were placed, is evidence of this recognition. Even yet, however, a large proportion of the general public is unaware of the importance of the chemist in industry, one of the causes of this being the fact that, unlike the French and the Germans, we do not in general distinguish between "chemists" and "pharmacists"; in fact, the term "chemist" is legally confined to compounders and vendors of medicine. Recognition by public opinion of the importance of the chemist is necessary in order to secure his adequate remuneration, and until this is secured there will be an insufficiency of chemists, and therefore no chemical industry worthy of the name. Recently, however, signs have not been wanting that the condition of the chemical industry and the position of the chemist are beginning, and likely to continue, to improve. The latest sign is the alteration in character of the Journal of the Society of Chemical Industry, upon which we venture to congratulate both the society and the review editor. The Journal has always been an exceedingly valuable one, but until recently it was rather machine-like, and the human element was chiefly conspicuous by its absence. In it one sought the abstracts under the heading of particular interest to oneself, and glanced at the titles of the papers to discover one of interest—and that was all. Now, however, that there is a review section, including articles of general interest, trade reports, Parliamentary and legal news, signed reviews of chemical books, reports of meetings of the different sections, and of those of other societies, almost every chemist will be able to pick up the Journal with the practical certainty of finding something of interest. Further, the Journal now has a better chance of appealing to those who are not chemists, and so helping to educate the public as to what a chemist really is.

We regret to see the announcement of the death, on January 23, of the veteran alienist, Dr. Henry Maudsley. He was born near Settle, in Yorkshire, in 1835, and he graduated from University College Hospital as M.D. of London in 1857. Through a busy professional life as superintendent of Manchester Asylum, physician at the West London Hospital, professor of medical jurisprudence at University College, and so on, he kept up a strong interest in psychological and philosophical problems, and he was for many years editor of the *Journal of Mental Science*. A keen intellectual combatant, absolutely sincere and fearless, he played a notable part among notable men at a time of great scientific activity—the last quarter of the nineteenth century. It was apparently under the influence of Herbert Spencer that Dr. Maudsley was early in the field in applying evolutionist conceptions to psychology. His "Responsibility in Mental Disease" appeared in 1874, and was the first of many works, such as "Physiology of Mind," "Pathology of Mind," "Body and Will," which did useful service to

psychological science in emphasising the intimate way in which physiological factors are bound up with psychical factors in the unified life of the creature. Central to his whole thinking was the idea of the unity of the organism in which mental and motor activities are closely correlated, and he never wavered from this position, which was vigorously expounded in his "Organic to Human," published less than a couple of years ago. Dr. Maudsley was essentially "tough-minded," and his pre-occupation with mental diseases probably exaggerated his distrust of "over-strained idealism of any sort." Deepest in his life, perhaps, was the desire to further by his investigations and thinking a scientific systematisation which would make for the relief of man's estate. Towards that end, ten years ago, he generously contributed 30,000*l.* to the London County Council for developing the treatment of mental diseases. What we venture to call his mood of scientific meliorism, sometimes shadowed, was expressed in the fine sentence: "By large and close and faithful converse with Nature and human nature in all their moods, aspects, and relations is the solid basis of fruitful ideals and the soundest mental development laid."

IN a recent number of *West Africa* (January 19) Mr. R. E. Dennett suggests the formation of a Union for the study of the British West African Colonies and the advancement of their interests in this country. Mr. Dennett begins by pointing out how necessary it is that British West Africa should have a showroom in one of the principal London thoroughfares, where produce and pictures of typical West African scenes could be displayed. The foundation of such a showroom might, he suggests, be the first step towards the formation of a union to co-ordinate work for British West Africa. There would be scope for talent of every kind in this union, since the activities of its sections would range over such diverse subjects as superstitions and mythology, sanitation, forms of government, banking, utilisation of produce, transport, hospitality to distinguished West Africans, and the care of West African students. Much work for West Africa is already being done, as Mr. Dennett admits, by the Imperial Institute, the Royal Colonial Institute, Kew Gardens, and various learned and other societies, and though he disclaims any intention of competing with existing institutions, the details of his scheme include suggestions for some work which is already being done. What is really needed at present is a union the main business of which would be to stimulate the organisations already at work for West Africa, including the Government, instead of trying to do any part of the work itself. It is well known, for example, that the quality of much West African produce needs improvement, that the agricultural and forest departments in these territories need larger staffs and more funds, and that further means of transport are required. A union competent to speak for West Africa would be usefully employed in directing public attention to these and other equally important matters, and in taking action through the proper channels to get them remedied. If such a union had existed it could scarcely have remained quiet when last month a great part of the exhibition galleries of the Imperial Institute, including the only exhibit of West African produce in London, was closed to the public by the Office of Works to accommodate a branch of the Ministry of Food.

LORD LEVERHULME discusses, in *Science Progress* for January, the question of the abolition of slums. The slum problem is, he observes, merely a case of bad "packing," because, while most towns have slums, the majority of them possess within their boundaries a sufficient area of land to accommodate three times their present population. Lord Leverhulme's suggestion is that each municipality should acquire, as occasion offers, the fringe of land on its suburbs, and that the municipality could afford to give this land to persons ready to build houses thereon. With the general adoption of the Town Planning Act the present scandalous condition of things might be removed.

SIR C. H. READ describes, in *Man* for January, two bronzes acquired from a Parsi in Bombay, who stated that his family had possessed them from time immemorial, and that they had been brought by one of his ancestors from Persia, where they had been attached to the gate of the city whence the Parsi family had come. They are castings by the wax process, known as *cire perdue*, and represent animals which at once recall the bull-like monsters of Assyria; but, at the same time, there are differences that may be of some significance. The Assyrian bulls are human-headed, and these also have human heads, but while the modelling of the bodies suggests a bull, the horns are unquestionably those of a sheep. This sheep has been identified by Lord Rothschild as *Ovis orientalis gmelini*, the wild sheep of Asia Minor and Armenia. It is possible that these bronzes were ultimately derived from Assyria, and as the relations between Assyria, Persia, and Armenia were intimate, the story of the Parsi may be correct. But many questions regarding the style and use of these bronzes, which will ultimately pass to the British Museum, await further investigation.

IT was stated in one of the morning papers a few days ago that "there have recently arrived in England evidences of the most important zoological discovery that has come to light since the finding of that strange beast, the okapi. . . . This discovery proves very completely the existence of a new and hitherto unknown species of elephant, a real dwarf elephant." All that has really happened is that two skeletons have just arrived in this country of a "dwarf" race of elephant described in the *Revue Zoologique Africaine* in 1913. Thus the announcement of this "discovery" is somewhat belated. The specimens just received are stated to be fully adult examples, but this is not yet certain, and will be determined by Dr. C. W. Andrews, of the British Museum of Natural History, to whom they have been submitted. But we have known of the existence of dwarf elephants in Africa since 1906, when the first of its kind was discovered. This came into the possession of Hagenbeck, the German dealer in live animals, who sold it to the Zoological Society of New York, in the gardens of which it is still living. This animal forms the type of the species *Elephas africanus pumilio*. The species referred to in 1913 was described under the name *Elephas africanus frennseni*. The specimen obtained by Hagenbeck now stands about 5 ft. high, but whether this is its maximum height is open to question, since its growth may have been checked by a troublesome skin disease from which it has long suffered. The specimens described in 1913, from Lake Leopold II., measured some 6 ft. in height, which is stated to be the height of the taller of the two animals the skeletons of which have just been received. These may not prove to be adult, so that the precise amount of dwarfness of these "dwarf" elephants has still to be determined, but it seems certain that they are far smaller than the typical African elephant, though they are giants compared with the extinct dwarf elephant of Malta.

IN the *Australian Zoologist* (vol. i., part 4, Sydney, October 8, 1917) there is an interesting article by Mr. Charles Hedley, director of the Australian Museum, on the economics of *Trochus niloticus*. This handsome shell was mistaken for a product of the Nile by Aldrovandus, who, in 1606, was the first writer in Europe to describe it. Mr. Hedley tells us that it is found on coral-reefs from Ceylon to Samoa, and as far north as Japan. The natives of various islands make use of the animal as food, and the periphery of the shell has been cut out and worn as a bracelet by the Papuans. But among civilised people it was only known to shell fanciers until a few years ago. "Exhaustion of former supplies of pearl shell and the increasing demand of recent years have promoted search for new sources of mother-of-pearl. Thus *Trochus niloticus*, or trocas, as it is sometimes called, having dense firm nacre, which proved good material for buttons, came to be exploited by manufacturers. During the past six years an active request for Trochus by button-makers has sprung up, advancing from 20*l*. to 30*l*. a ton." The Great Barrier Reef is being fished for Trochus, from Torres Straits southwards to Port Mackay. The export of Trochus from Queensland in 1915 was 544 tons, worth 12,000*l*., and in 1916 was 950 tons, worth 23,000*l*. The Philippine Islands export about 320 tons annually. From Western Australia the exports of Trochus were :—For 1912, 52 tons; for 1913, 66 tons; for 1914, 19 tons; for 1915, 73 tons; for 1916, 26 tons. There are also large fisheries in New Guinea, the Solomon Islands, and Fiji. Some Japanese fishermen carefully save both meat and shell. From ten tons of shell a ton of meat is obtainable, worth, in China, 20*l*. a ton. Mr. Hedley considers that the annual Australian crop of Trochus is likely soon to deteriorate under the present active fishery.

THE annual report of the Department of Agriculture, Nyasaland, for the year ending March 31, 1917, contains much interesting matter. The exports of tobacco, tea, and cotton constitute a record for the Protectorate, and the past year has been particularly favourable for agriculture generally, despite the difficulties arising out of the war and the absence of many planters on military service. The increased demand for tobacco is a direct result of the privileged admission of British-grown tobacco into the United Kingdom, and, despite high prices for freight, the industry is very prosperous, and has now established itself in the home market. Nearly 1000 more bales (400 lb.) of cotton were exported than in the previous year, and the acreage under European cultivation is now 29,580. Tobacco first appeared as an article of export in 1899, and, despite freight charges, has managed to establish itself against American competition. Tea to the extent of 420,685 lb. was exported, whilst in the previous year the amount was 288,341 lb. The great difficulty with regard to Nyasaland products is that of freight and transport, and much damage to cotton and tobacco results during the difficult journey to the coast. There is also the drawback that owing to delays the planter can seldom realise on his crops within one year of the date of shipment, thus necessitating double capital, or planting on advance rates, which eat deeply into profits. Until direct railway communication with the coast can be established this promising land will remain very severely handicapped.

THE *Scientific American*, in its issue of December 22 last, directs attention to the low efficiency of massed rifle fire at ranges less than 500 yards. It appears that the best results ever obtained were by the Boers at Colenso, when in full daylight and from a sheltered position they succeeded in making one hit in 600 shots fired against an enemy thoroughly exposed in the open. This lack of success of the rifle at close ranges leads to its being regarded rather as a handle for a bayonet than as an effective weapon itself. It seems that no amount of preliminary training or of adjustment of sights can eradicate the tendency of the rifleman to shoot too high when under mental stress. To overcome this difficulty Col. Ely, of the American Army, has invented an attachment weighing only 2 oz. which, when adjusted, prevents the rifle being discharged when its angle of elevation exceeds a given value. The records obtained with the device are about twenty-four times as good as the Colenso results, but it does not appear to have been adopted by the American military authorities.

THE importance of modern methods of welding in enabling repairs to be executed quickly has been brought out by a recent account in *Engineering* (January 11) of the methods adopted for making good the damage done by the Germans on vessels interned in U.S. ports. The principle of electric welding has been applied to fifteen ships in the port of New York, and all these are now in commission and probably ready for service. Bulletin No. 98 of the University of Illinois Engineering Experiment Station is also of interest, and gives an account of tests of oxyacetylene welded joints in steel plates. The plates employed varied in thickness from No. 10 gauge to 1 in., and were subjected to various heat treatments. The tests include static loads, repeated loads, and impact. The welds were made by skilled workmen. For joints with no further treatment after welding, the joint efficiency for static tension was found to be about 100 per cent. for plates up to $\frac{1}{2}$ in. thick, and to decrease for thicker plates; these joints show an efficiency not greater than 75 per cent. for the material in the joints, but were strengthened by working the metal after welding and weakened by annealing at 800° C. Repeated stress tests followed in a general way the results of the static tests. Hammering or drawing the weld while hot increases the strength. The impact tests show that oxyacetylene welded joints are decidedly weaker under shock than is the original material; for joints welded with no subsequent treatment, the strength under impact seems to be about half that of the material. If the welded joint is worked while hot, the impact-resisting qualities are slightly improved. Annealing from 800° C. seems to have very little effect on the impact-resisting qualities.

MESSRS. H. K. LEWIS AND CO., LTD., hope to publish in the course of the next few weeks vol. i. of "Regional Surgery," a work by American and British authors, in three volumes, edited by Dr. J. F. Binnie, Gould's "Pocket Medical Dictionary," Stitt's "Tropical Diseases," and Stitt's "Practical Bacteriology." The first consignment of these books was lost at sea by a gale.

THE twentieth issue of "The Scientist's Reference Book and Diary"—that for 1918—has now been published by Messrs. Jas. Woolley, Sons, and Co., Ltd., of Manchester, at the price of 2*s*. 6*d*. As usual, it consists of two parts: the first is a storehouse of physical and chemical constants, definitions, and important scientific facts; and the second is a conveniently arranged diary and memorandum book. The two are bound together in a leather case suitable for carrying in the pocket.

THE following books are announced for publication during February by Messrs. Chapman and Hall, Ltd. :—"The Chemistry of Colloids," by Prof. R. Zsigmondy, translated by Prof. E. B. Spear, part ii.,

Industrial Colloidal Chemistry, by Prof. E. B. Spear, and a chapter on Colloidal Chemistry and Sanitation by Prof. J. F. Norton; "An Introduction to Theoretical and Applied Colloid Chemistry," by Dr. W. Ostwald, translated by Prof. M. H. Fischer; "Biochemical Catalysts in Life and Industry: Proteolytic Enzymes," by Prof. J. Effront, translated by Prof. S. C. Prescott and C. S. Venable; "Practical Pyrometry," by E. S. Ferry, G. A. Shook, and J. R. Collins; "Hand Grenades," by Major G. M. Ainslie; "Ordnance and Gunnery," by Lt.-Col. W. H. Tschappat; "Hydro-Electric Power-Stations," by E. A. Lof and D. B. Rushmore; "A Practice Book in Elementary Metallurgy," by Prof. E. E. Thum; "Testing for the Flotation Process," by A. W. Fahrenwald; an enlarged edition of "Practical Instructions in the Search for, and the Determination of, the Useful Minerals, including the Rare Ores," by A. McLeod; "The Development of Forest Law in America," by J. P. Kinney; and reprints of "Scientific and Applied Pharmacognosy," by Prof. H. Kraemer, and "Applied and Economic Botany," by Prof. H. Kraemer.

OUR ASTRONOMICAL COLUMN.

THE PLANET SATURN.—This beautiful telescopic object will be in opposition to the sun on January 31, and will be very favourably placed for telescopic scrutiny during the ensuing few months. There is evidence to show that much the same phenomena occur on Saturn as on Jupiter, and that occasionally disturbances on a considerable scale occur in the atmosphere of the former object. Yet it has not been very successfully observed when we compare the results with those obtained with regard to Mars and Jupiter. The far greater distance of Saturn and the less conspicuous character of the markings are no doubt in part responsible for this, but sometimes, as in 1903, the spots and irregularities in the belts are very plain and numerous.

The rotation period of Saturn requires redetermination, for the markings in different latitudes exhibit proper motions. Prof. Hall's white equatorial spot of 1876–77 gave a period of 10h. 14m., whereas the dark and light markings which were visible in the north temperate region in 1903 indicated a period of about 10h. 38m., or twenty-four minutes longer.

UNIT OF STELLAR DISTANCE.—As a step towards the extension of the decimal system to celestial measurements, and the unification of units in the statement of stellar distances, it is suggested by M. de Rey Pailhade that a convenient unit would be 10^{10} kilometres (*L'Astronomie*, December, 1917). A light-year is equivalent to 946 of such units, or approximately 1000, which is a number easily remembered. The parsec, which corresponds to 3·25 light-years, is very closely 3000 units, and the distance of 61 Cygni would be expressed by 5865. On the same system, the mean distance of the earth from the sun is 0·015, and that of Neptune 0·450. The symbol suggested for the new unit is Us (*unité stellaire*), but this does not seem to be well adapted for countries other than France.

RELATIVITY AND SHIFTS OF FRAUNHOFER LINES.—According to Einstein's theory of relativity, the lines in solar and stellar spectra should be displaced towards the red by an amount depending upon the difference in gravitational potential between the gravitational field in which the lines originate and the terrestrial field where the radiation is received. In the case of the sun the theoretical displacement is equivalent to the Doppler displacement due to a radial velocity of 0·634 km. per sec., and at $\lambda 5000$ amounts to 0·010 A. With the powerful instruments now in use in solar observations such a shift of the lines should be easily measurable. The question has been taken up at Mt. Wilson by Dr. St. John, who has selected some of the band lines of cyanogen as the most suitable for the purpose, in consequence of their freedom from displacements due to pressure (*Astrophysical Journal*, vol. xlvi., p. 249). The mean sun *minus* arc displacement at the centre of the sun for the forty-three band lines measured was zero, while for thirty-five lines at the limb it was only +0·0018 A. It cannot be assumed, therefore, that the Einstein effect is annulled at the centre by an outward radial motion of the solar vapours, as the effect of such a motion would vanish at the limb and the gravitational effect should appear. The observations accordingly give no evidence of a displacement of the lines of the order of magnitude required by the principle of relativity.

THE "ANNUAIRE ASTRONOMIQUE" FOR 1918.—The current issue of this useful publication maintains the high standard reached in former years. Besides the usual tables relating to the sun, moon, and planets, it includes a series of charts showing the aspect of the heavens in each month, and interesting notes on a great variety of astronomical subjects. A general review of progress in the various departments of astronomy and meteorology is a valuable feature. The Annuaire is published at 3 francs by the Librairie Ernest Flammarion, Paris.

PARIS ACADEMY OF SCIENCES.

PRIZES PROPOSED FOR THE YEAR 1919.

Mathematics.—Francœur prize (1000 francs), for discoveries or works useful to the progress of pure or applied mathematics.

Mechanics.—Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts, and the practical and speculative sciences; Poncelet prize (2000 francs), for work useful to the progress of mechanics.

Astronomy.—The Lalande prize (540 francs), for the most interesting observation in, or memoir most useful to the progress of, astronomy; Benjamin Valz prize (460 francs), for work on astronomy under similar conditions to those of the Lalande prize; G. de Pontécoulant prize (700 francs), for the encouragement of work in celestial mechanics.

Geography.—Gay prize (1500 francs). The question proposed for 1919 is the study of the physical geography of North Africa, and principally Mauritania; Tchihatchef foundation (3000 francs), for recompense or assistance to naturalists distinguished in the exploration of the lesser-known parts of Asia, excluding British India, Siberia, Asia Minor, and Syria.

Navigation.—The prize of 6000 francs, for work increasing the efficiency of the French naval forces; Plumey prize (4000 francs), for improvements in steam engines or any other invention contributing to the progress of steam navigation.

Physics.—Kastner-Boursault prize (2000 francs), for the best work on the various applications of electricity in the arts, industry, and commerce; Gaston Planté prize (3000 francs), to the author of a discovery, invention, or work important in the field of electricity; Hébert prize (1000 francs), for the best treatise or most useful discovery for the popularisation and practical use of electricity; Henri de Parville prize (1500 francs), for original work in physics; Hughes prize (2500 francs), for an original discovery in the physical sciences, especially electricity and magnetism and their applications; Pierson-Perrin prize (5000 francs), for a discovery in physics.

Chemistry.—Montyon prize (unhealthy trades) (one

prize of 2500 francs and one mention of 1500 francs), for the discovery of a means of rendering some mechanical art less unhealthy; Jecker prize (10,000 francs), for the author of the work most useful to organic chemistry; Cahours prize (3000 francs), for the encouragement of young men already known to have done good work, more particularly by researches in chemistry; Houzeau prize (700 francs), for a young chemist of merit.

Mineralogy and Geology.—Delesse prize (1400 francs), for work in geology, or, alternatively, in mineralogy. It may be divided. Joseph Labbé prize (1000 francs), for geological work or researches with reference to the mineral wealth of France, its colonies or protectorates, or, in default, to recompense the author of any work made in the general interest.

Botany.—Desmazières prize (1600 francs), for the best work on cryptogams published during the preceding year; Montagne prize (1500 francs), to the author or authors of important discoveries or works on the cellular plants; Jean Thore prize (200 francs), for the best memoir on the fluviatile or marine algæ of Europe, or on mosses, lichens, or European fungi; de la Fons Mélicocq prize (900 francs), for the best work on the botany of the North of France; de Coincy prize (900 francs), for a work on phanerogams; Jean de Rufz de Lavison prize (500 francs), for work in plant physiology.

Anatomy and Zoology.—Cuvier prize (1500 francs), for work in anatomy and zoology; Savigny foundation (1500 francs), for the assistance of young travelling zoologists, not receiving a Government grant, who specially occupy themselves with the invertebrates of Egypt and Syria.

Medicine and Surgery.—Montyon prize (three prizes of 2500 francs, three honourable mentions of 1500 francs, citations), for discoveries or improvements during the year in medicine or surgery; Barbier prize (2000 francs), for a discovery valuable in surgery, medicine, pharmacy, or in botany having a relation to the art of healing; Bréant prize (100,000 francs), the capital sum is offered to anyone discovering a specific cure for Asiatic cholera or for the discovery of the causes of this terrible scourge; Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the urino-genitary organs; Chaussier prize (10,000 francs), for the best book or memoir showing an advance in legal or practical medicine; Mège prize (10,000 francs), to the author who continues or completes the essay of Dr. Mège on the causes which have retarded or favoured the progress of medicine from antiquity to the present day; Bellion prize (1400 francs), for works or discoveries especially profitable to the health of man or the amelioration of the human species; Baron Larrey prize (750 francs), to a doctor or surgeon belonging to the Army or Navy for the best work presented to the Academy in the course of the year dealing with military hygiene, surgery, or medicine; Argut prize (1200 francs), for a discovery allowing the cure, by medicine, of a disease up to the present only capable of being dealt with surgically.

Physiology.—Montyon prize (750 francs), for the most useful work in experimental physiology; Lallemand prize (1800 francs), for work relating to the nervous system in the fullest sense of these words; Philipeaux prize (900 francs), for experimental physiology; Fanny Emden prize (3000 francs), for the best work treating of hypnotism, suggestion, and generally of physiological action exerted at a distance from the animal organism.

Statistics.—Montyon prize (one prize of 1000 francs, two mentions of 500 francs), for statistical researches of any nature.

History and Philosophy of the Sciences.—Binoux prize (2000 francs).

Medals.—Arago medal, awarded by the Academy at any time that a discovery, work, or service rendered to science appears worthy of this testimony of high esteem; Lavoisier medal, awarded under conditions applying to the Arago medal, for services rendered to chemistry; Berthelot medal, to holders each year of the prizes in chemistry.

General Prizes.—Prize founded by the State (3000 francs), question for 1919: researches on the geographical and bathymetric migrations of fishes and on the conditions which govern them; Bordin prize (3000 francs), question for 1919: in the theory of integrals of total differentials of the third species and double integrals relating to an algebraic function of two independent variables, the existence of certain numbers (*nombres entiers*) has been demonstrated, of which it is difficult to obtain the value, and may depend on the arithmetical nature of the coefficients of the equation of the surface corresponding with the function. The Academy requires a profound study of these numbers in particular cases. Vaillant prize (4000 francs), question for 1919: to discover a photographic layer, without visible grain, and as sensitive as the gelatino-bromide at present in use; Petit D'Ormoy prize: two prizes of 10,000 francs each, one for pure or applied mathematics, the other for natural science; Jean Jacques Berger prize (15,000 francs), for work relating to the city of Paris; Saintour prize (3000 francs), for work in the mathematical sciences; Henri de Parville prize (1500 francs), for a book on original science, or popularisation of science; Lonchampt prize (4000 francs), for the author of the best memoir on the diseases of man, animals, or plants from the special point of view of the introduction of mineral substances in excess as the cause of the disease; Henry Wilde prize (one of 4000 francs, or two of 2000 francs), for a discovery or work on astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; Gustave Roux prize (1000 francs); Thorlet prize (1600 francs).

Special Foundations.—The Lannelongue foundation (2000 francs), for one or two persons at most, in reduced circumstances, belonging themselves, or by their marriage, or parents, to the scientific world, with preference to medicine. Laplace prize, for the pupil leaving the Ecole Polytechnique holding the first place. L. E. Rivot prize (2500 francs), divided between the four pupils leaving the Ecole Polytechnique each year with the first and second places in the divisions of *mines* and *ponts et chaussées*. Normal School prize (2000 francs) will be awarded after the conclusion of the war to an old pupil, killed or wounded in the field, in recompense or in view of scientific work.

Funds for Scientific Research.—Trémont foundation (1000 francs); Gegner foundation (4000 francs); Jérome Ponti foundation (3500 francs); Henri Becquerel foundation (3000 francs); Bonaparte foundation (50,000 francs); Loutreuil foundation (125,000 francs); Charles Bouchard foundation (5000 francs).

GLASS TECHNOLOGY.

WE have now before us Nos. 1 to 3 of the Journal of the Society of Glass Technology. The first of these has already been noticed in these columns (NATURE, July 26, 1917). The two additional numbers now available indicate the healthy progress of this new society, and augur well for the renewed vitality of the glass industry in this country. The papers which appear in this journal cover a wide range of subjects and vary very considerably in size and

value; they may, perhaps, be regarded as somewhat minor contributions to a great subject, but that is as much as can be expected at a time when all our best energies are devoted to "doing" rather than to writing or talking about what has been and is being done. Thus, Sir Herbert Jackson's address, "Some General Observations on Glass," is interesting and suggestive, but obviously deals only with some of the fringes of the great work on which its author is known to be engaged.

Two subjects of very great immediate interest and importance are, however, dealt with in these Journals. The first of these relates to refractories. The papers by Fearnsides, Davidson, Rosenhain, and Cosmo Johns form part of a special discussion on refractories for the glass industry held by the society in Sheffield as a supplement or extension of the discussion on this subject inaugurated by the Faraday Society. On the basis of these papers the Society of Glass Technology was able to formulate the requirements of the glass industry in regard to refractories and to submit these to a conference on refractories afterwards held in London. This activity is of very considerable importance, because it is hoped that as the result of these conferences a "Refractories Research Association" may shortly be formed, for the purpose, in the first place, of furnishing fresh support and co-ordination for the various researches on refractories already in progress at various centres, such as the pottery laboratories at Stoke-on-Trent and at the National Physical Laboratory, and also of initiating much-needed additional researches both at those institutions and, possibly, elsewhere. The interests of the glass industry are most intimately concerned with this whole question of refractories—indeed, it is probably not too much to say that progress in glass manufacture depends almost entirely on progress in refractories. It may be hoped, therefore, that the Society of Glass Technology will give its best efforts to support this movement for research on refractories. Above all, it is to be hoped that no spirit of local or provincial jealousy will be allowed to interfere with the proper distribution and development of this work, whether at Sheffield, Stoke, or Teddington.

The second subject of great and immediate scientific and industrial interest touched upon in this journal is the question of the behaviour of glass in contact with chemical reagents and the correlated question of the testing of chemical laboratory glassware. This is a subject which, before 1914, had received very considerable attention in Germany, and there was a natural tendency to look to the work of the "Reichsanstalt" for guidance in these matters. The necessity for producing satisfactory laboratory glass in this country has led to a new and independent attack on the whole subject, and it has wisely come to be recognised that if the laboratory glass industry is to flourish in England after the war, it must be reinforced by an adequate system of testing by some recognised institution which will afford to the buyer and user of the ware an adequate guarantee of its good quality. The institution and organisation for dealing with a system of testing of this kind are, fortunately, already in existence at the National Physical Laboratory, and only need the provision of additional accommodation and staff to allow of their immediate application to the whole industry.

The question of the precise nature of the tests to be applied, however, is more difficult. Here, as in all cases where the power of prolonged endurance of an article or a material is to be tested, it is necessary to devise some accelerated test which shall—in a few hours or, at most, days—furnish an indication of the probable behaviour of the article in ordinary use over a period of months or years. In such cases it is difficult, if not impossible, to retain similarity or proportionality in the tests in such a way that the article giving the best test shall also be that which gives the best actual wear in use. In the case of glassware, in which resistance to hot water and to acids and alkalis and to such vigorous reagents as ammonium chloride and ammonium sulphide is demanded, as well as resistance to sudden changes of temperature and adequate mechanical strength, the problem is particularly complex—thus a variety of glass specially resistant to hot water may not be so resistant to hydrochloric acid, while a glass having a high degree of thermal endurance may not be adequately resistant to water.

The whole question of the tests to be applied has now been systematically studied for a considerable time, both at the National Physical Laboratory and by a special committee of the Institute of Chemistry, while two papers, by Messrs. Westwood, Cauwood, and Turner, and Messrs. Cauwood, English, and Turner respectively, in the present journal, furnish an interesting and important contribution to the subject. It may be hoped that agreement on this matter, sufficient to arrive at a working specification for routine testing, may soon be arrived at, and that the National Testing Bureau for Glass may commence its beneficent work for the British glass industry at no distant date.

X-RAYS AND THE WAR.[1]

It was close on two years before the first formal meeting of the Röntgen Society, just twenty years ago, that Röntgen had stumbled, so to speak, across a new type of radiation, the wonderful properties of which excited the whole civilised world.

Since then the art of radiography has gradually extended into fields once never dreamt of. A present-day development, very typical of the times, is the detection of contraband metals, the examination of autogenous welds, and the scrutinising of steel and other metal castings and plates for faults and blow-holes. Such work demands high voltages and the heaviest outputs. Already steel plates more than 1 in. thick have been successfully examined.

But the all-important use of the X-rays is their medical application. Every hospital of any size now has its X-ray department, and there are many thousands of radiologists—both medical and laymen—devoting their lives to the work. X-ray technique has improved so vastly as to give the diagnostic methods of physician and surgeon a facility and exactitude never deemed possible at one time.

In the large military hospitals the great majority of wounded soldiers are X-rayed. The examination of wounds and injuries by X-rays has, in fact, become routine practice, whether in the field, by the use of the ingenious and cleverly designed motor-lorry outfits, or in the base hospitals. The X-ray has become as indispensable as the dressing or the splint, and it is an essential adjunct in prescribing and directing, as well as avoiding, operations. Even sprains are radiographed to find whether there is any slight bone fracture—as there very often is.

The X-ray detection of embedded bullet and shell fragments is now so certain as to be commonplace. Bullets and shrapnel are found and removed from any part of the body, even from the lung and brain or in the region of the heart. Precise instruments for localisation in the actual operating theatre are now in use, and even during the operation itself the surgeon's instrument may be guided to the foreign body. Stereoscopic fluoroscopy is possible, and if a practical apparatus could be produced it would be of incalculable

[1] Abridged from the Presidential Address delivered to the Röntgen Society on November 6, 1917, by Capt. G. W. C. Kaye.

value to the surgeon and radiologist in their combined efforts.

Unless there is a suspicion of septic poisoning a bullet is generally best left alone, but shell fragments are usually dirty, and the nature of the damage they inflict along their course makes it important that their exact position should be known. It is in such cases that X-ray stereoscopy attains its fullest delicacy. For example, the location of small foreign bodies near the eye, or actually in the eyeball, can be carried out to the hundredth of an inch.

In the case of a fracture the stereoscopic radiograph reveals the direction of the fracture and the disposition of the broken bone, and so assists the surgeon in deciding on the method of reparation. After the bone has been set, the progress of the recovery can be clearly followed in the subsequent photographs—whether the parts are joining up, whether new material is forming. The sequence of radiographs is included in the record of each case. The total number of photographs already taken at the various hospitals since the war commenced amount to many hundreds of thousands. Very valuable data will be obtained when time allows the radiologist to go carefully over all the accumuated records of cases.

The value of the X-rays in diagnosing chest complaints has been established again and again in this war. This is the case particularly with incipient tuberculosis, where early diagnosis is of great importance. Not only the diagnosis, but the treatment of tubercular glands has been attended with considerable success. Great attention has been paid in this war to the soldier's teeth, and very rightly. Here, again, the X-rays are playing their part and dental radiology has become an important subject. No more than mention can be made of the splendid work of "opacity" radiology, which can diagnose with routine certainty diseases of all parts of the alimentary canal. This has been of great service in examining Army recruits of doubtful medical fitness.

A word should be said as to the invaluable results obtained from single-flash exposures, especially in heart and lung conditions. Another war development of radiology is its employment by the orthopædic surgeon in his efforts to restore damaged limbs.

But the beneficent effects of the X-rays do not end with radiography. They have achieved wonderful results, not only in the diagnosis, but also in the repair of wounds. Amongst the minor tragedies of the war, few are more pathetic than the ghastly mutilations and disfigurements caused by shell wounds of the face and head. Many of our soldiers would seem to be doomed to a life of perpetual misery and humiliation, but by the wonderful plastic operations of the surgeon they can be restored to at least a semblance of their former selves. The radiologist's part in such work is to render scar-tissues pliant, to depilate hair from the scalp and skin surfaces concerned, to render the transferred flaps of skin pliant and more adaptable to their new positions, and to stimulate generally the healing process in both flaps and bone. For these purposes he employs radiation treatment, either X-rays or radium rays.

In the treatment of septic wounds and persistent sinuses, the most extraordinary success has resulted from a combination of X-rays and ultra-violet rays. Hyperthyroidism, or "soldier's heart," has been successfully treated by X-rays and radium rays.

The electro-therapeutist has also been prominent in war work. Countless electrical departments have been established in military hospitals throughout the country for the treatment of war injuries. Quite one-half, if not more, are gunshot wounds of the nerves with paralysis of the muscles. These cases are sent for electrical examination of the injured nerves and subsequent electrical treatment. Many cases of war wounds, more particularly those of the uncomplicated but inert type which refuse to heal, are treated electrically. Simple application of a direct current stimulates the process of repair, and sluggish wounds at once commence to heal. "Trench feet," which occurred in large numbers last winter, receive benefit by electrical treatment. Cases of shell-shock and neurasthenia and other functional disorders of the nervous system, some of which are seldom or never seen in times of peace, are now being cured in large numbers by electrical means.

And so the story goes on. The radiologist and the radio-therapeutist have found their reward in the gratitude of many men to whom they have once more made life endurable.

The outbreak of war found the X-ray manufacturers, like everybody else, quite unprepared. The greatest credit is due to them for the splendid way they threw themselves into the breach and turned out, in record time, unprecedented numbers of outfits for the Army. The X-ray bulb manufacturer was at once confronted with the absence of the glass, which Germany had hitherto supplied. The English glass manufacturer had to face the task of producing a uniformly good glass which would stand up, without puncturing, to the high voltages which obtain in practice. The problem was very difficult, but it is gradually being surmounted by State aid. In the meantime our American and French friends came to the rescue.

It is remarkable how slight have been the changes in design experienced by the target tube. He would be a bold man, nevertheless, who would assert that the present design has approached finality. All X-ray tubes are, in fact, extraordinarily inefficient things. Under favourable conditions they make use of rather less than one part in one thousand of the energy imparted to the cathode rays.

The Coolidge tube, first introduced nearly four years ago, has been considerably improved in detail, and now claims pride of place among X-ray tubes. It is not entirely free from defect, and its rays are no more homogeneous than those from an ordinary bulb, but its elasticity, precision, ease of control, long life, and relative freedom from inverse current make it an invaluable addition to the radiologist's equipment. Some wonderful output figures have been obtained by Coolidge on experimental water-cooled models. One tube was run continuously for many hours at 200 milliamperes and 70,000 volts, the power input being 14 kilowatts, *i.e.* about 19 h.p. It is anticipated that this figure will be shortly increased to 50 kilowatts.

It was hoped on its introduction that the Coolidge tube would be the means whereby X-rays approximating to the hardest γ rays from radium would be obtainable. Such anticipations have not been realised. In some recently published work Sir E. Rutherford describes measurements on the very hardest rays emitted by a Coolidge tube excited by close on 200,000 volts. In order to filter out the hardest rays present he passed them through 1 cm. of lead, the reduction in intensity being more than a millionfold. The residual rays proved to have a wave-length of about 0·06 Å.U., which may be compared with Rutherford's latest estimate of the wave-length of the hardest γ rays from radium C—between 0·02 and 0·007 Å.U. In other words, the Ra γ rays in question corresponded with X-rays generated by voltages between 600,000 and 2,000,000—figures to which no X-ray tube of present-day design could possibly stand up, even if we had the means to produce such voltages on a practical scale.

As to the composition of the X-rays generated by an X-ray bulb, we know now that the rays consist in general of two groups:—

(*a*) A continuous spectrum of rays with a sharply

defined boundary on the side of the shorter wave-lengths, the position of such boundary depending on the voltage on the tube.

(*b*) One or more characteristic radiations (of the ... J, K, L, M, ... series), each approximately homogeneous and characteristic of the metal of the anticathode. The higher the atomic weight the more penetrating the radiation in the same series.

The proportions of (*a*) and (*b*) depend entirely on the conditions. With very soft tubes a large proportion of the radiation may be wholly characteristic.

With reference to the spectrum of general rays, it has recently been shown that the maximum frequency of X-ray which a tube can yield can be readily calculated by a simple extension of Planck's quantum theory. The relation in question (due to Einstein) is $Ve = h\nu$, where V is the voltage on the tube, e the elementary charge on each cathode ray, ν the frequency of the hardest X-ray produced, h is Planck's constant. e and h are known with considerable exactness, so that we have the means of calculating very readily the voltage necessary to generate a particular X-ray. Inserting Millikan's latest values of these constants, we have

$$\text{Wave-length in Å.U.} = \frac{12{,}400}{\text{voltage}}.$$

The accuracy of this simple relation has been confirmed experimentally over a wide range of voltages in America. It will be noticed that the result is independent of the material of the anticathode.

With reference to the characteristic radiations, each consists of a number of spectral lines. For these, Einstein's simple law does not hold, a greater voltage being required. Webster noticed that the various spectral lines of a series all spring into being together as the voltage is increased through the critical value.

Through the medium of the X-rays we have unveiled a few of the secrets of the structure of the atom. The biggest development has resulted from the discovery of the wave-like character of the X-rays. It was Laue and his pupils in 1913 who first demonstrated the diffraction of X-rays by crystals, but it was in this country that the first real insight into the problem came. The Braggs showed how the crystal reflection of X-rays could be utilised to separate out different waves in a fashion exactly analogous to the production of interference colours by thin plates. The X-ray spectrometer revealed both the atomic spacings of a large number of crystals and the absolute wave-lengths of a variety of monochromatic X-rays.

The work of Moseley stands out pre-eminently here. Moseley photographed many characteristic X-ray spectra, and measured the wave-lengths of the principal lines. He was able at once to obtain the very remarkable and simple relation now associated with his name, namely, that the frequency of a characteristic X-ray from any element is proportional to the square of the atomic number of the element. This atomic number must be distinguished from the atomic weight. It denotes merely the order in which the elements come when arranged according to their atomic weights. Thus the atomic number of hydrogen is 1, of helium 2, of lithium 3, and so on. The atomic numbers follow the order of atomic weights except in three instances: argon and potassium, cobalt and nickel, iodine and tellurium are interchanged.

The X-ray spectra are revealed as an extreme type of light-ray spectra, and are even more characteristic of the parent atom. Later work has shown that X-ray spectra contain many lines and are much more complicated than was first believed.

Moseley's work has been extended by others, notably by Siegbahn and Friman. We now know the atomic numbers of all the known elements, beginning with hydrogen and ending with uranium—with an atomic number of 92. Each of the atomic numbers is represented by an element, with the exception of numbers 43, 61, 75, 85, and 87, which stand for five elements waiting to be discovered. It by no means follows, however, that there are only five missing elements; five is a lower limit, for we now know that several elements may have the same atomic number. Such isotopes, as Soddy has called them, cannot be distinguished one from another by ordinary chemical or physical tests. They are grouped together under the one atomic number in the periodic classification of the elements, but, nevertheless, they may, and do, possess atomic weights differing by several units. It is apparent that the atomic number is something more than a mere integer; it undoubtedly represents some fundamental attribute of the atom, and as the work of Rutherford and others has shown, the atomic number equals the excess number of positive charges in the nucleus of the atom.

The boundaries of the known spectrum have been considerably extended since the war broke out. In the ultra-violet Lyman has extended the region first investigated by Schumann to a wave-length of about 500 Ångström units, and Richardson and Bazzoni have very recently further extended this to 420 Å.U. The longest X-ray so far measured by Siegbahn has a wave-length of 12 Å.U. Rutherford has recently given evidence for believing that the wave-length of the hardest γ rays from Ra-C is in the region of 1/100 Å.U. We are thus now familiar with a range of more than ten octaves of X- and γ rays without a break—not at all a bad record for so young a subject. There still remain about five octaves to be explored in the region between X- and ultra-violet rays, a region which contains the characteristic X-rays of the light elements from hydrogen to neon.

And now to turn to quite a different topic. At the moment we are all reproaching ourselves for our past neglect of science in this country. We are paying the penalty of our indifference, despite the wonderful adaptability and resource which this war has shown we possess as a nation. The country is slowly learning its lesson. Willy-nilly, we are being led to see at last that our system of education misdirects much genius into unproductive channels, and we are awakening to the importance of research, both pure and applied.

The value of applied science to industry is now accepted throughout the country, and British industry should begin to feel the benefit, especially now that the principle of State-aided research is established.

But we must not forget that it is the pure academic research, unrestricted and unprescribed, which has been the prime cause of all the radical changes in industrial methods. Research in pure science is rarely appreciated by the general public or manufacturer, for it cannot be done to order. One must put faith in the research worker that he may continue to have faith in himself. Much of what he will do will be discontinuous and abortive, but he must not be hampered by utilitarian notions being continually rammed down his throat. If he does not solve the original problem he will probably solve some other which has sprung from it, and one successful discovery may outweigh by far all his failures.

The equal importance of the applied research worker, who is responsible for turning to account the discoveries of the pure investigator, must not be lost sight of for a moment. There is no line of demarcation between the two divisions of research. Each involves study, hard work, and thought. The methods of both branches are questioning and searching; the common end is knowledge, to which there is no heaven-sent road.

What has been the reward of the research worker

in the past? It is the shameful truth that the man of science, with few exceptions, has received little or no recognition by the mass of the people of this country, who, unknowing and uncaring, have been perfectly content to allow him the status, both social and financial, which he himself has modestly sought for his everyday life and wants. But the country, in its hour of need, has turned to its scientific sons for help in its war problems, and has not turned in vain. The war is bringing home to the nation the dependence of its very existence on science, and a little good may come out of a very great evil if public opinion can be brought to realise that the statement is as true in peace as in war, and that a nation's administrators should always include among them suitable men of the highest technical and scientific standing, not merely to advise, but also to initiate and direct.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At a special Degree Congregation held on Thursday, January 24, the Vice-Chancellor (Col. Gilbert Barling, C.B.) conferred the honorary degree of Doctor of Laws on Lord Morris, late Premier of Newfoundland.

LONDON.—The following doctorate has been conferred by the Senate:—*D.Sc. in Statistics:* Miss Kirstine Smith, an internal student, of University College, for a thesis entitled "On the standard deviations of adjusted and interpolated values of an observed polynomial function and its constants, and the guidance they give towards a proper choice of the distribution of observations."

WE learn from the *Times* that in reply to an inquiry as to whether Mr. Andrew Carnegie would make good the damage to the science building at Dalhousie University, Halifax, N.S., which was originally his gift, the reply received from the trustees of the Carnegie Corporation, New York, was that they would "consider it a privilege to pay for repairing the damage."

NEW scales of salaries, necessitated partly by the increase in the cost of living, have been, or are being, drawn up for teachers in primary and secondary schools, but so far nothing has been done in London towards improving the salaries of technical teachers, salaries which even before the war were already too low. Failure to do this is, in part, due to the fact that no "Fisher grants" similar to those given for elementary and secondary education have been available for technical education. A meeting to consider the matter has been arranged by the Association of Teachers in Technical Institutions to be held at the Polytechnic, Regent Street, W.1, on Saturday, February 2, at 3 p.m. All teachers in technical institutions, junior technical schools, and trade schools (whether members of the association or not) are invited to attend.

WE have received the annual report of the committee of the Aberdeen Public Library for the year 1916–17. The committee realises that public libraries should prepare for the coming period of reconstruction by providing their readers with the most authoritative books in pure and applied science. It is felt that people in all departments of industry are beginning to see more clearly the value of a thorough scientific knowledge of their craft, and that they will therefore ask for books which contain the most recent information instead of being content with books which are now out of date. Acting upon the advice of a special sub-committee, under the convenership of Prof. J. Arthur Thomson, the committee has discarded a large number of obsolete scientific books in order to make room for up-to-date works, including technical books on every handicraft known to be followed in Aberdeen. In the Reference Department of the Aberdeen Library the trade and technical periodicals, dictionaries and encyclopædias, business directories, gazetteers and atlases form a "commercial library" similar to those which have been established in Glasgow and Liverpool. The purpose of such commercial libraries is to make immediately available the best and most recent information as to all matters affecting trade and commerce. We congratulate the Aberdeen Library Committee upon the steps it is taking to increase the efficiency of the library and to make it a centre for the spread of accurate knowledge in all branches of industry and commerce.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, January 16.—Mr. E. Heron-Allen, president, in the chair.—Presidential address: The Royal Microscopical Society during the great war and after. The president gave a review of the war conditions under which the society has met since August, 1914, and of such part of the work of the society as is ripe for publication in connection with the war. He gave an analysis of the work of the society's abstractors during the periods 1901–13 and 1914–17, and adumbrated a contraction and specialisation of the activities of the society in the future, in the direction of the technical optics of the microscope and its application to all branches of industry and research.

Linnean Society, January 17.—Sir David Prain, president, in the chair.—E. S. **Goodrich**: The restoration of the superficial bones of the head of the fossil fish Osteolepis. Having shown the restorations of Pander, Gregory, and Watson, which differ considerably from each other, Mr. Goodrich described his own restoration of the bones and lateral-line canal system, and directed attention to the importance of an accurate knowledge of the structure of such an early and primitive form as Osteolepis, from the Lower Devonian strata, for a correct interpretation of the homologies of the cranial bones in the higher fishes and in the land vertebrates.—J. **Britten**: Some early Cape botanists.—C. E. **Salmon**: A hybrid Stachys. The plant originated in the author's garden, where previously only *Stachys germanica* and *S. alpina* were cultivated; it was identical with *S. intermedia* [Solander in] Ait. Hort. Kew, ii., 301 (1789).

MANCHESTER.

Literary and Philosophical Society, December 11, 1917.—Mr. T. A. Coward, vice-president, in the chair.—W. **Thomson**: Somatose. Somatose is a substance prepared by dissolving the refuse from meat which has been extracted with water with the view of producing meat extract. In South America this refuse material was thrown into the sea. A German chemist found that he could dissolve part of this refuse fibrin by heating it with water under a pressure of 90 lb. to the square inch—that is, at a temperature of 320° F. By filtering and evaporating this solution to dryness he obtained a horny grey mass, which, on being powdered, constituted somatose. It was held by some that the value of somatose as a food could be determined by the amount of nitrogen it contained, and that the nitrogen equivalent in somatose was equal to the nitrogen equivalent in lean beef. With the view of determining this, the author considered that it could be done only by feeding animals with food containing lean beef on one hand and somatose on the other.

He made these experiments by feeding tame mice, and found that, whilst the mice throve upon a mixture of oats and lean beef, they did not thrive upon a mixture of oats and somatose, and whilst the one set increased in weight the other fluctuated more or less largely below their original weight, and he came to the conclusion that somatose should be classed more appropriately as a poison than as a food.

PARIS.

Academy of Sciences, January 7.—M. Paul Painlevé in the chair.—P. **Appell**: Oblique aerial movements of light spheres possessing weight.—G. **Giraud**: Hyperabelian functions.—S. **Lattès**: The iteration of rational substitutions and the functions of Poincaré.—J. **Chokhate**: Some properties of the polynomials of Tchebicheff.—A. **Denjoy**: A general property of analytical functions.—A. **Guillet**: The experimental determination of a moment of the form, $X\frac{d\theta}{dt}$, and of an apparent inertia arising from the viscosity of a fluid.—A. **Mailhe**: A new method of preparation of the nitriles by catalysis. Ammonia and methyl benzoate vapour are passed together over thoria at 450°–470° C.; benzonitrite, C_6H_5CN, is the main product. The reaction is similar when ethyl benzoate is employed. Ortho- and para-toluonitriles and phenylacetonitrile can be made by the same method.—A. **Pictet** and J. **Sarasin**: The distillation of cellulose and starch in a vacuum. Under a pressure of 12 mm. to 15 mm. cellulose gives a little water, and then, between 200° and 300°, a heavy yellow oil, which sets to a semi-crystalline mass. About 10 per cent. of charcoal remains in the retort. The pasty mass is about 45 per cent. of the cellulose taken, and, after purification, forms white, tabular crystals, identical in all respects with Tanret's lævoglucosane. Starch on distillation gives the same product with the same yield.—S. **Menteath**: The defile of Navarre. The tectonic of this defile is a continuation across the Pyrenees of the structure of the layers of Dax, Bastennes, and Salies-de-Béarn; it cannot be taken as typical of the structure of the Pyrenees chain.—L. **Gentil** and L. **Joleaud**: Geology of the region of Tunis.—L. **Dunoyer**: Diurnal variations of the wind in altitude. A theory is developed which affords an explanation of the results of observations described in an earlier paper (*C.R.*, 1917, p. 1068).—J. **Peyriguey**: Two water-spouts observed at Rabat, December 18, 1917.—R. **Souèges**: Embryogeny of the Alismaceæ. Differentiation of the radicular extremity in *Sagittaria sagittaefolia*.—J. **Silhol**: The use of kapok for dressings. A description of the properties of kapok compared with those of cottonwool, especially from the point of view of materials for dressing wounds. Kapok exerts selective absorptive properties, removing micro-organisms from pus.—M. **Adrian**: The use of certain marine algæ as food for horses. An account of feeding experiments in which a treated seaweed was used in place of oats for feeding horses, with marked success. The seaweed was accepted, digested, and assimilated by the animals. The laminaria utilised are abundant on the Breton coast.

WASHINGTON, D.C.

National Academy of Sciences, September, 1917 (Proceedings, vol. iii., No. 9).—J. **Loeb**: Heliotropic animals as photometers on the basis of the validity of the Bunsen-Roscoe law for heliotropic reactions. New quantitative experiments proving that the "instinctive" motions of animals to light are phenomena of automatic orientation and a function of the light intensity, the function being the Bunsen-Roscoe law of photochemical action.—H. G. **May**: The appearance of reverse mutations in the bar-eyed race of Drosophila under experimental control. Such a phenomenon is not difficult of explanation on the theory that it is produced by a chemical change in the constitution of some substance.—L. R. **Cary**: The part played by Alcyonaria in the formation of some Pacific coral reefs. On certain of the Pacific reefs the Alcyonaria are important coral-forming agents; their relative importance can be determined only after borings have been made through some reefs to determine the history of the reefs.—A. G. **Mayer**: Observations upon the alkalinity of the surface water of the tropical Pacific.—H. H. **Plough**: The effect of temperature on linkage in the second chromosome of Drosophila. Both high and low temperatures produce an increase in the percentage of crossing over. The crossing over appears to take place in the stage when the chromosomes are known to be finely drawn-out threads, not in the early oogonial divisions or in the late thick thread stage.—A. H. **Sturtevant**: Genetic factors affecting the strength of linkage in Drosophila.—H. **Seares**: Further evidence on the concentration of the stars towards the galaxy.—C. **Barus**: Theoretical relations in the interferometry of small angles.—J. A. **Harris**: Interperiodic correlation in the egg production of the domestic fowl. The results make possible the selection of groups of birds of high annual egg production from the trapnest records of individual months.—E. W. **Washburn**: Two laws governing the ionisation of strong electrolytes in dilute solutions and a new rule for determining equivalent conductance at infinite dilution derived from conductivity measurements with extremely diluted solutions of potassium chlorite. In sufficiently dilute solution all uni-univalent salts of strong acids and bases obey the mass-action law, and all have the same ionisation constant; the values of the mass-action expression for all such salts are identical, the identity persisting up to higher concentrations the more nearly the salts resemble each other.—E. C. **MacDowell** and E. M. **Vicari**: The growth and fecundity of alcoholised rats. Both growth and the fecundity of the alcoholised are subnormal as compared with non-alcoholics.

October, 1917 (Proceedings, vol. iii., No. 10).—G. M. **Green**: The general theory of curved surfaces and rectilinear congruences. Preliminary announcement of the number of theorems in a field which seems to be promising.—J. P. **Iddings** and E. W. **Morley**: A contribution to the petrography of southern Celebes. Twelve analyses of lavas from Celebes.—A. G. **Mayer**: The non-existence of nervous shell-shock in fishes and marine invertebrates. Corroboration of the conclusion that war-shock is predominantly a psychic phenomenon and, being hysteria, can be cured by hypnotic suggestion.—A. R. **Moore**: Chemical differentiation of the central nervous system in invertebrates. In the cephalopod, caffein brings about hyper-irritability of the cerebral ganglia, while camphor affects the stellar ganglia in the same sense. Atropin causes spasms in the squid, but inhibits the activity of the chromatophores. Camphor shows a selective action in the shrimp, paralysing the elements, controlling backward swimming, and exciting those controlling forward motion.—W. E. **Garrey**: Proof of the muscle-tension theory of heliotropism. Experiments show that the motion of animals to or from a source of light are due to an influence of the light on the tension of muscles of different sides of the body.—W. H. **Longley**: Changeable coloration in Brachyura. The colours of crabs and their capacity to change them vary from species to species, according to the same general rule that appears to prevail among fishes.—J. F. **McClendon**: The equilibrium of Tortugas sea-water with calcite and aragonite. The surface water

of the sea is the supersaturated solution of $CaCO_3$, and it is only necessary to introduce calcite crystals in order to cause precipitation of this substance.—H. J. **Muller**: An Œnothera-like case in Drosophila. Report of an extended series of experiments showing that it will not do to accept evidence apparently in favour of factor inconstancy without the support of highly rigorous factorial analysis.—A. G. **Mayer**: Is death from high temperature due to the accumulation of acid in the tissues? Death is probably due to the formation of acid rather than to coagulation of proteid substances.

VICTORIA.

Royal Society, November 8, 1917.—Prof. W. A. Osborne, president, in the chair.—R. S. **Rogers**: *Chiloglottis pescottiana*, sp. nov. The species was found at Tallangatta, and is distinguished from others of the genus in the distribution of the calli and the form of the labellum.—Miss N. C. B. **Allen**: Magnetic deflection of rays; tabulation of *v* against RH, assuming Laurentz theory.—F. **Chapman**: The occurrence of Acrotreta in Lower Palæozoic (Lancefieldian and Heathcotian) shales. The discovery of this genus in Victoria further supports the conclusion as to the Upper Cambrian age of the Heathcotian and associated beds. The new species is related to *A. belti* from the Lower Tremadoc of North Wales and to *A. transversalis* of the St. John Group, New Brunswick.—F. **Chapman**: An apparently new type of Cetacean tooth from the Tertiary of Tasmania. *Scaptodon lodderi* is represented by a flattened conical tooth with a small bevelled crown, which is otherwise allied to teeth of the Physeter type.

BOOKS RECEIVED.

Solectrics: A Theory explaining the Causes of Tempests, Seismic and Volcanic Disturbances, and other Natural Phenomena: How to Calculate their Time and Place. By A. J. Cooper. Pp. 213. (London: J. D. Potter.) 6*s*.

Ambulance de l'Océan. La Panne la Prothèse du Membre Inférieur. By Dr. F. Martin. Pp. viii+107. (Paris: Masson et Cie.) 5 francs.

The Philosophy of Benedetto Croce. The Problem of Art and History. By Dr. H. Wildon Carr. Pp. x+213. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Notions d'Acoustique. Instruments de Musique; le Telharmonium. By J. Rodet. Pp. 96. (Paris: Gauthier-Villars et Cie.) 3.50 francs.

The Scientist's Reference Book and Diary, 1918. (Manchester: J. Woolley, Sons, and Co., Ltd.) 2*s*. 6*d*.

Carnegie United Kingdom Trust. Report on the Physical Welfare of Mothers and Children. Scotland. Vol. iii. Pp. xxviii+625+illustrations. (Dunfermline: Carnegie U.K. Trust.)

Third Melbourne General Catalogue of 3068 Stars for the Equinox 1890, from Observations made at Melbourne Observatory during the Period 1884–87 to 1894–1900. Pp. viii+77. (Melbourne: A. J. Mullett.)

DIARY OF SOCIETIES.

THURSDAY, JANUARY 31.

ROYAL SOCIETY, at 4.30.—The Growth of Trees: A. Mallock.—Action of Light Rays on Organic Compounds, and the Photosynthesis of Organic from Inorganic Compounds in Presence of Inorganic Colloids: Prof. B. Moore and T. A. Webster.—The Isolation and Serological Differentiation of *Bacillus tetani*: Capt. W. J. Tulloch.—An Investigation into the Periodicity of Measles Epidemics in the Different Districts of London for the years 1890–1912: Dr. J. Brownlee.

ROYAL INSTITUTION, at 3.—Revolving Fluid and the Weather Map: Sir Napier Shaw.

FRIDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 5.30.—Gravitation and the Principle of Relativity: Prof. A. S. Eddington.

SATURDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 3.—The Ethics of the War: P. H. Loyson.

MONDAY, FEBRUARY 4.

ROYAL SOCIETY OF ARTS, at 4.30.—High-temperature Processes and Products: C. R. Darling.

ARISTOTELIAN SOCIETY, at 8.—The Theory of a Limited Deity: Bishop of Down.

TUESDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 3.—The Problems of British Anthropology: Prof. A. Keith.

ROYAL SOCIETY OF ARTS, at 4.30.—The Industrial Resources of South Africa: C. du P. Chiappini.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The West Quay of Madras Harbour: The Hon. Sir Francis J. E. Spring and Hugh H. G. Mitchell.

RÖNTGEN SOCIETY, at 8.15.—A Simple Means of Obtaining "Static Currents" from an Induction Coil: Dr. G. B. Batten.—A Mobile Snook Apparatus: E. E. Burnside.

ZOOLOGICAL SOCIETY, at 5.30.—Notes on the Dingo in Australia: T. E. Whitehead.—Notes on the Skull of *Rana tigrina*: Prof. B. L. Bhatia and Baini Prashad.—Description of a New Snake of the Genus Oligodon, from Upper Burma: G. A. Boulenger.—A New and a Rare Species of the Golden Mole (Bematiscus): Dr. R. Broom.

WEDNESDAY, FEBRUARY 6.

ROYAL SOCIETY OF ARTS, at 4.30.—The Development of the Mineral Resources of the Empire: Prof. W. Frecheville.

SOCIETY OF PUBLIC ANALYSTS, at 5.—Annual General Meeting.—A Modified Acetic Acid Reagent for Valenta Tests: A. E. Parkes.—Oiticica Oil—a New Drying Oil: E. Richards Bolton and Cecil Revis.

GEOLOGICAL SOCIETY, at 5.30.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, FEBRUARY 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Photo-Electric Action of X-rays: Prof. O. W. Richardson.—The Parent of Actinium: F. Soddy and J. A. Cranston.—The Absorption of the Radiation Emitted by a Palladium Anticathode in Rhodium, Palladium, and Silver: E. A. Owen.

ROYAL INSTITUTION, at 3.—Illusions of the Atmosphere: The Travelling Vortex and the Cyclonic Depression: Sir Napier Shaw.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Ninth Kelvin Lecture: Kelvin as a Teacher: Prof. M. Maclean.

LINNEAN SOCIETY, at 5.—Two Bibliographical Rarities of the Society's Library: (*a*) Cupani, F., "Panphyton siculum," 1713; (*b*) Du Gort, J. and P., "L'Histoire et Pourtrait des Plantes," Lyon, 1561: The General Secretary.—Plant Distribution from the Standpoint of an Idealist: H. P. Guppy.

FRIDAY, FEBRUARY 8.

ROYAL INSTITUTION, at 5.30.—Science and Ethics: Principal E. H. Griffiths.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

SATURDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 3.—The Ethics of the War: P. H. Loyson.

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THURSDAY, FEBRUARY 7, 1918.

BIOLOGY FROM AMERICA.

(1) *The Organism as a Whole, from a Physico-chemical Viewpoint.* By Dr. Jacques Loeb. Pp. x+379. (New York and London: G. P. Putnam's Sons, 1916.) Price 2.50 dollars.

(2) *Organic Evolution. A Text-book.* By Prof. R. S. Lull. Pp. xviii+729. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 3 dollars.

(3) *Biology.* By Prof. Gary N. Calkins. Second edition, revised and enlarged. Pp. viii+255. (New York: Henry Holt and Co., 1917.)

(1) A BOOK by Dr. Jacques Loeb is always very welcome, for he bases new ideas on new facts, and these are often surprising. The central idea of this book is not new—that organisms are "chemical machines consisting chiefly of colloidal material and possessing the peculiarity of preserving and reproducing themselves"; but many of the facts illustrating this definition are new, and many of them are the rewards of the author's own industry and ingenuity.

What are the distinctive features of a living creature from Dr. Loeb's point of view? First, there is the constant synthesis of specific material from simple compounds of a non-specific character; secondly, there is the division of the cell when it reaches a certain limit; thirdly, there is the whole business of fertilisation and subsequent development. But when these features are carefully examined in the light of modern knowledge their apartness from inanimate phenomena tends to disappear. Is anything more specific than fertilisation, yet a strange spermatozoon may be got to enter an inappropriate ovum if the surface conditions of that ovum be modified by artificially altering the chemical concentration of the medium, and the manifold ways of artificially launching a non-fertilised ovum on the voyage of development are well known.

The generic characteristics of a type seem to depend on the specificity of the proteids in the ovum-cytoplasm; and the unity of the organism in development, and afterwards, depends on the unified organisation of the ovum-cytoplasm, which contains the organism "in the rough." On this the Mendelian factors or genes (probably hormones in the nucleus) may impress varietal or stock characters in the course of development. Very interesting is the author's suggestion that special sex-determining chromosomes may hinder or favour the formation of specific internal secretions which have developmental potency, and, on the other hand, that an environmentally induced change in these internal secretions might even counteract the chromosomal sex-determination. It need scarcely be said that, according to Dr. Loeb, there is nothing in instincts to remove them from a mechanistic category; and we are likewise assured that "the mere laws of chance are adequate to account for the fact of the apparently purposeful adaptations."

Sometimes the author seems to us impetuous, as in his acceptance, in spite of Prof. Castle's work, for instance, of the conclusion that Darwin's small fluctuating variations are not heritable. But whether one agrees or not, the book is always stimulating, and in the majority of cases the author is ready with chapter and verse, *i.e.* with facts and experiments, in support of his contention.

Perhaps the author is not responsible for the statement on the wrapper that "Darwinism had reached the conclusion that the harmonious character of the organism as well as its adaptation to the environment was the result of chance," but he is responsible for the erection of a "bogey" vitalism, the overthrowing of which does not tax his strength. In the genus vitalism there are several species, some of which are already extinct, while others are in process of elimination, but it is not of the essence of methodological vitalism to make an antithesis between the physico-chemical and the vital, between materiality and mind. Dr. Loeb considers the organism as the seat of a concatenated and correlated series of physico-chemical operations. So do all biologists. But to methodological vitalists it seems that the physico-chemical descriptions, invaluable as they are, do not exhaust the reality before us, do not adequately describe the living, growing, developing, varying, struggling, and sometimes companionable organisms that we know. We do not speak of more general grounds for finding it impossible to believe that from a physico-chemical viewpoint one can ever envisage the organism as a whole.

It is not perhaps of great importance, but we must direct attention to the curious statement in the preface that "the book is dedicated to that group of freethinkers, including d'Alembert, Diderot, Holbach, and Voltaire, who first dared to follow the consequences of a mechanical science—incomplete as it then was—to the rules of human conduct, and who thereby laid the foundation of that spirit of tolerance, justice, and gentleness which was the hope of our civilisation until it was buried under the wave of homicidal emotion which has swept through the world." Wave of homicidal emotion, forsooth!

(2) Prof. R. S. Lull has written a useful text-book of organic evolution, compendious but clear, and very generously illustrated. The introductory part deals with what may be called the facts of life—the variety of types, their distribution in time and space, their interrelations, and so on. The treatment of the geological succession is particularly effective. The second part is entitled "The Mechanism [rather a question-begging term] of Evolution," and the treatment is broad-minded and eclectic. The discussion of orthogenesis and kinetogenesis is interesting, and the balance of Nature is picturesquely illustrated. The author then passes to the evidences of evolution, and, after a brief discussion of recapitula-

tion, leaves the beaten track and gives the student a delightful account of adaptations to various modes of life—such as running, burrowing, swimming, climbing, and flying—and of adaptations to various haunts—such as deserts, caves, deep sea, and inside other animals. This section extends over about 200 pages, and it is very instructive. Prof. Lull gets the student to see that every fact of life that admits of genetic interpretation is an "evidence of evolution," and he works successfully with the idea which Osborn called "adaptive radiation," that around many a central or focal type we may group an often-repeated series of similar solutions of the problem of livelihood.

The last section of the book is palæontological. Selecting three great lines—molluscan, arthropod, and vertebrate—Prof. Lull sketches the probable evolution of the highest class of each, namely, cephalopods, insects, and mammals. With the aid of the abundant illustrations the reader gets some feeling of the movement, both progressive and retrogressive, of the evolutionary process. No student can fail to be impressed, for instance, with the case of the nautiloid Lituites, which "went through the orthoceran, cyrtoceran, gyroceran, and nautilian stages, and as it became adolescent left the close coil and reverted to the orthoceran stage."

The part of the book that deals with the evolution of vertebrates seems to us the most distinctive; the author is there dealing with subjects around which most of his own investigations have centred. He is inclined to accept Prof. Chamberlin's hypothesis of the origin of vertebrate animals in flowing land water; he traces back terrestrial forms to a probable derivation from Crossopterygian fishes earlier than the Upper Devonian; Dinosaurs arose from a primitive Cotylosaurian Carboniferous stock; birds from a stock common to them and Ornithischian Dinosaurs; mammals from reptiles like Therapsids; and man from primitive anthropoids. Without ever pretending to finality, Prof. Lull balances various theories, and the student will appreciate the methodical questioning in regard to each important type: What was the probable ancestral stock? When and where did the emergence occur? What were the probable evolutionary factors? Most characteristic of the whole treatment is the correlation of organismal and environmental changes, which, even when tentative, is full of interest and suggestion. "The stream of life pulses irregularly as it flows. There are times of quickening, the expression points of evolution which are almost invariably coincident with some great geologic change. . . . The geologic changes and the pulse of life stand to each other in the relation of cause and effect." In any case, climatic changes and organismal evolution are correlated.

(3) We have already had an opportunity (NATURE, vol. xciv., 1915, p. 504) of expressing our appreciation of the first edition of the fresh and stimulating introduction to biology which Prof. Calkins has worked out. It is an eminently educative book, and the second edition is even better than the first. Galton is still called Dalton, but that is a microscopic fly in the ointment. We mention it, however, since we directed attention to it before. J. A. T.

SCHOOL-LIFE IN THE SEVENTEENTH CENTURY.

About Winchester College. By A. K. Cook. To which is prefixed *De Collegio Wintoniensi*, by R. Mathew. Pp. xvii+583. (London: Macmillan and Co., Ltd., 1917.) Price 18s. net.

THAT a boy should have been moved to write an account of his school, in which he enumerates the warden, masters, chaplains, clerks and organist, the seventy "children," the sixteen "quiristers," their gowns and other garments, the servants and their several offices, the hours of rising, meals, and lessons, and to describe the food, the games and other occupations, is difficult of explanation. That Robert Mathew's 286 hexameter lines should have been preserved is most remarkable. His picture of life at Winchester in 1647—it is a machine drawing rather than a picture—can have had no interest for his contemporaries. They were too familiar with the details which he sets forth with the pedantic accuracy of a valuer's inventory. He had no prevision of their interest to posterity. Documents of this kind are extremely rare. Students of sociology may search in vain such famous chronicles as the Mahawanso, in which a long succession of Buddhist priests recorded, from year to year, the current history of the Sinhalese from the first establishment of their kingdom, for evidence of the ways and occupations of the people. Does the *Times* describe a man's evening dress? The uniform and obvious calls for no description.

To a student of Wykehamical customs, or of the functioning of any other academic body, Mathew's poem is of surpassing interest. It is used by Mr. Cook as a fixed point from which he surveys the college life—backwards to its foundation, forwards to the present time. Since the days when he entered as a schoolboy to his retirement from a mastership, his life has been spent in the college precincts, save for the usual interval at New College, Oxford. The book is indispensable to Wykehamists. To others, who had not the privilege of education in the "best of all schools," it is a delightful pastime to gaze at the moving views of the social life of five passing centuries. However enthusiastic the reader may be for the Newest Education, the reflection will give him pause that boys have, apparently, made progress under a system in which all his axioms were inverted.

Even the physiologist will find himself constrained to admit that the genus Boy is, or was, a more adaptable creature than he supposed. To take a few illustrations out of the many to which one would like to direct attention. "Surgite" was at 5 a.m., summer or winter. Having put on gowns, breeches, and shoes, the "children" sweep their chambers and make their beds; then

they go downstairs and out to the conduit to wash their faces and hands. (The regulations of Eton and Westminster only required them to wash their hands.) There were no baths, and, as at Cambridge and at Glasgow, "going into the water" in the Meads was an offence against propriety which earned a flogging, if not expulsion. Of floggings on all days, but organised on Bloody Friday, it is unnecessary to speak. No food before 9, whether the early morning was spent in school or "on Hills," then bread and beer for breakfast; at 12, for dinner, boiled beef, bread, and beer; 3.30, bevers of bread and beer; 5, supper of mutton, bread, and beer; "further refreshment" before going to bed, and a nipperkin of beer in chambers, to last the night. (It reminds one of F. W. Maitland's discovery, "Doomsday Book and Beyond," that the allowance of a Canon of St Paul's, probably including two servants, was eighteen gallons a week.) Vegetables are not mentioned, and there is no reason for thinking that they were comprised in the diet. "In winter we may, perhaps, be allowed a fire in Hall"—charcoal, in a brazier, beneath the lantern in the roof. There was no other fire in college. And, for mental food, Latin and Greek authors, with, "on Saturdays, for the higher classes, the catechism of Nowell (the learned divine) in Greek, by heart." Mathematics, taught by the writing master, made a timid entry towards the end of the eighteenth century. Physical science was first tolerated (the word is used advisedly) in 1867.

All servants were male, with the exception of one *anus culinae* (old woman in the kitchen) over an, apparently, short period, and the nurse who made her appearance in Sick-House just after Mathew had left. The list is of great interest as pointing the contrast between the economic conditions of the seventeenth century and modern times: one manciple, one bread-butler, one beer-butler, two cooks, one baker, two brewers, one miller, one horsekeeper, one gardener, one porter, two scullions, one cleaner of trenchers, one old woman of the kitchen. As in all other colleges, the society killed their own beef and mutton, ground their own wheat, baked their own bread, grew their own hops, and brewed their own beer. For a society of 105 persons, of whom most of the scholars and all the "quiristers" performed many menial duties for the masters as well as for themselves, the establishment was large and "economically" wasteful. A. H.

ORGANIC CHEMICAL ANALYSIS.

Allen's Commercial Organic Analysis. Fourth edition, entirely re-written. Vol. ix. Edited by W. A. Davis. With index for all the volumes. Pp. xviii+836. (London: J. and A. Churchill, 1917.) Price 30s. net.

THE issue of this volume marks the completion of a task begun some ten years ago, when the production of a revised and entirely re-written edition of Allen's well-known work was undertaken. Ten years is a somewhat lengthy period in modern chemical history. A considerable amount of literature dealing with organic analysis has appeared during the last decade, and many new processes have been devised within this period; it was therefore desired to bring the text of the whole work, and especially of the earlier volumes, as nearly "up to date" as was practicable. This has been done in the present volume—the ninth—by means of a series of supplementary articles, written for the most part by the original contributors, and embodying any noteworthy advances in the various branches of organic chemical analysis dealt with in the eight preceding volumes.

Without attempting to indicate by any means all the additional matters, mention may be made of a few out of many interesting points noted on looking through the book.

In the section on "Alcohols" a method is given for the detection and estimation of methyl alcohol in ethyl alcohol, which marks a real advance in the subject. By this method, due originally to Denigès so far as the detection is concerned, the presence of as little as 0·2 per cent. of methyl alcohol in ethyl alcohol can be detected with certainty within twenty minutes, and only twice as much time is required to estimate the proportion of methyl alcohol with sufficient exactness for most purposes.

For the estimation of starch, particularly in foliage leaves and similar material, a method of employing taka-diastase is recommended. Starch is converted by taka-diastase into maltose and dextrose, free from the dextrin produced with ordinary diastase of malt. The resulting sugars are determined by the usual methods.

In the article on "Butter" it is of interest to note that the composition of margarine has undergone great changes during the last few years. Except in the case of margarine intended for pastry and cooking, the use of animal fats is rapidly dwindling; their place has been taken by products obtained from the coconut and palm kernel. A certain percentage of butter fat, however, is often present. The various changes have made the analysis of modern margarine mixtures a very complicated problem. The introduction of hydrogenated ("hardened" or "semi-hardened") fats complicates the matter still further, as the process of hydrogenation largely destroys the identity of the original oil or fat.

An abuse of scientific knowledge is indicated in connection with the production of essential oils. Artificial esters such as terpinyl acetate, glyceryl acetate, and ethyl citrate are prepared for use as adulterants of these oils. The esters, as is doubtless well known to the persons who employ them, have chemical characters such that essential oils adulterated with the esters appear to contain natural esters considerably in excess of the artificial adulterant added. Methods for the detection of such admixtures are indicated in the book.

Since the previous articles on alkaloids were written, a good deal of work on individual alkaloids has been published, but not much which affects alkaloids as a class. The question of the

mode of formation of vegetable alkaloids is still left open, but on the whole it is considered that the work done recently rather supports the view that alkaloids are formed from the decomposition products of proteins. As regards the function of alkaloids in plants, the view most widely accepted now is that they are ultimate products of metabolism, and of no further use to the plant. Among useful new processes of alkaloid analysis may be mentioned the citrate method of estimating quinine (p. 516) and the ferrocyanide process for quantitatively separating strychnine from quinine (p. 518).

The volume contains a two-hundred-page index to the whole work, which is indispensable to analytical laboratories dealing with organic products. The editor is to be congratulated upon the successful completion of his lengthy task.

C. S.

OUR BOOKSHELF.

Om Laegekunst hos Perserne. By A. Christensen. Pp. 103. (Medicinsk-historiske Smaaskrifter, 18.) (København: Vilhelm Trydes Forlag, 1917.)

THIS small work of one hundred pages constitutes the eighteenth pamphlet of the Medicinsk-historiske Smaaskrifter edited by Vilhelm Maar and published in Denmark. We have reviewed the other volumes in a previous issue, and regret that an announcement in the present pamphlet indicates that the series, for the present at any rate, has reached a conclusion. The subject of Persian medicine has been dealt with by many historians, and Dr. Christensen has brought our knowledge up to date. He divides the matter into four chapters: the Zoroaster period, ancient Islam medicine, the period of Avicenna, and recent Persian medicine. An appendix with a translation of one of the four treatises of the "Tchahar makala" of Nizami-i-Aruzi (twelfth century) completes the account. The medicine of the Avesta, the original document of Zoroaster's religion, is fully dealt with, and the influence of Ahura Mazda, the all-wise spirit, in maintaining health is analysed. The demoniacal concept of disease and its production through the agency of Anro Maiynus —the evil mind—is carefully considered. The fall of the Sassanian empire in the seventh century and its conquest by the Arabs has had a profound influence on the subject of medicine, for it was through the Arabs, notably Rhazes and Avicenna, that the great works of classical antiquity were restored to European learning, enriched with the valuable commentaries of these diligent students of the dark ages. Dr. Christensen's researches constitute a distinct addition to our knowledge of this interesting period.

The "Wellcome" Photographic Exposure Record and Diary. Pp. 256. (London: Burroughs Wellcome and Co., 1918.) Price 1s.

THIS well-known pocket-book has all its usual features, in spite of the exigencies of the times. The main article has been rewritten, and gives concise but sufficient directions for the use of "tabloids" in all the usual photographic operations. It includes development by time and temperature, tank development, factorial development, fixing, intensification and reduction, and printing processes, the use of various development papers, carbon printing, and oil pigment printing, the making of lantern slides, various toning and staining processes, and colour photography by means of autochrome, Dufay and Paget colour plates. The mechanical calculator attached to the cover, with the necessary tables and lists, from which the photographer will select those details that apply in his particular case, has established its trustworthiness and convenience by many years of experience. A useful diary, plenty of space for recording exposures, a copious index, sundry tables, etc., and two illustrations "from the front," or very near it, complete the volume. It is interesting to note that in the classified lists of photographic materials there are given considerably more than two hundred different kinds of plates and films, forty-five kinds of bromide paper, and twenty-nine kinds of lantern plates, although German and Austrian goods are excluded.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The British Scientific Instrument-making Trade.

THE progress of science as the result of experience gained during the present war will call for increased effort on the part of British manufacturers of scientific instruments at the conclusion of hostilities. Moreover, the knowledge gained by our principal enemy by virtue of the British blockade will give her a lead over us in many directions, since she has been forced to bring the brains of her leaders of scientific thought to bear on many problems of vital moment to the life of their country.

From this it would seem as if British scientific instrument makers were called upon to co-operate more closely than has been the case in the past, if they are to meet the competition they will be called upon to face as soon as Germany is in a position to reconstruct her industries when relieved from the burden of war.

The object of the present letter is to suggest the formation of an institution which, while retaining most of the features of existing scientific societies, will provide means for greater effort in collaboration, as regards training, research, and propaganda, with the view of increasing the field for British-made instruments. As was pointed out by the present writer in an article in NATURE of August 16, 1917 (vol. xcix., p. 488), Germany has always realised the value of research as applied to the instrument-making trade, but the same cannot be said for this country. One of the first tasks, then, confronting such an institution, if established, would be the installation of a properly equipped and staffed laboratory, in which investigations could be carried out (1) in the interests of individual members, (2) in the interests of the general body of members. It may be objected that this would mean usurping the functions

of the national laboratories, but this would scarcely be so, since the institution laboratory would devote its attention more to the creation of new types of apparatus, the outcome of improved methods of teaching, and the perfection of existing types, rather than to the purely theoretical ascertainment of data on which standard apparatus is based. It must not be forgotten that there are many small firms whose means are insufficient to allow of their bearing the somewhat heavy charges levied by the national institutions for extended research work

The discussion of methods of manufacture would constitute another important function of the institution. Certain firms no doubt meet with difficulties which could often be cleared up by free discussion, just as members of other scientific institutions profit by the experience gained by their colleagues. There are very few, if any, treatises on the manufacture of instruments. Most of the existing books on the subject come from Germany, and several of them have never been translated. Thus it will be seen how original papers and discussions could be made into a permanent record.

Such questions as the standardisation of designs and the study and improvement of the designs of other countries could also be very suitably dealt with in an institution intended for the general development of the industry.

As regards the organisation of the proposed institution, this could follow, generally, the lines of existing scientific societies, with extensions to cover the particular activities suggested by individual firms. It is expected, of course, that the first cost would be heavy, and would necessitate the co-operation of the entire instrument-making trade; but surely it is worth while if the ultimate benefits to be conferred upon the trade were made permanent, as they could not fail to be. The question should be dealt with at once, for indications are not lacking that Germany is relaxing no effort to secure, by co-operation and concentration on the part of her leading manufacturing concerns—and probably scientific instrument makers also—the dominant position she held at the outbreak of the war.

E. S. HODGSON.

Coventry, February 5.

THE NATIONAL FOOD POLICY.

THE columns of the daily Press have for many months past furnished adequate evidence of the controversy which is raging in agricultural circles as to the lines upon which national policy should be framed with the view of securing the maximum of efficiency in the production and husbanding of food supplies. That part of the question which relates to animal production may be said to have been brought to a focus in the notable conference of representative agriculturists from all parts of the country which met on Friday last to receive statements on the position from Lord Rhondda and Mr. Prothero.

Mr. Prothero indicated clearly that the dominating factor by which national policy in this matter must be guided is the great shortage of concentrated feeding-stuffs. Basing his conclusions upon estimates of the supplies of such feeding-stuffs which are likely to be available before next harvest, and postulating as self-evident that working horses and milch cows must be adequately, though not extravagantly, provided for in the first instance, Mr. Prothero found that the remaining supplies of concentrated food available for other classes of live-stock were far from sufficient to enable these to be fed in the same numbers or on the same lines as has been customary in past years. Whilst expressing the opinion that ample freedom should be left to the individual farmer to determine how he can utilise inadequate food supplies to the best advantage, Mr. Prothero outlined suggestions as to the kind of ration of concentrated feeding-stuffs which might be regarded as giving a reasonable apportionment to different classes of stock. A considerable reduction in the numbers of certain classes of live-stock was inevitable, but the farmer must endeavour to mitigate this by growing as much food as possible at home for his stock.

The address of Lord Rhondda was punctuated freely with criticism from the audience, especially when outlining the reasons which had led to the existing policy of control of meat and milk supplies. This policy had been rendered necessary owing partly to the undue rise in meat prices even when supplies were relatively plentiful, and partly to the necessity of keeping meat production within moderate limits in view of the restricted supplies of concentrated feeding-stuffs and the more efficient utilisation thereof in other directions.

From the reports of the meeting in the Press it is evident that the conference was not entirely successful, owing to no opportunity being afforded the audience of discussing the many controversial matters raised by the speakers. This view was expressed in a leading article in the *Times* of February 2, the writer then proceeding to criticise adversely certain items of the food policy of the Government, and incidentally to throw doubt upon the competence of the scientific investigator to furnish trustworthy guidance in the matter of the economical utilisation of food supplies. "Scientific calculations about food," said the writer, "are a very untrustworthy guide to practice, because the data on which they are based are quite inadequate to justify the conclusions drawn from them." The reply of the scientific worker came promptly in Tuesday's *Times* from the pen of Prof. E. H. Starling, with the retort that science is "nothing but practical experience accurately noted, recorded, and classified." The data upon which the man of science bases his calculations are furnished entirely by practical experience, and include all such data as are detailed and accurate. The practical man can have no other data which will render his conclusions more trustworthy, and, indeed, in all too many cases the individual practical critic has little regard for data of any description in the formulation of his opinions.

It is surprising to find that the attitude of the writer of the *Times* article on this point is apparently determined by the views expressed in a letter in the same issue contributed by Mr. C. B. Fisher, "a well-known agriculturist of wide experience," who is referred to as writing "in the moderate tone of a man who is master of his subject." It is doubtful whether Mr. Fisher would entirely accept the latter description, but it is clear from

his letter that whatever be his mastery of the practical aspect of the subject, he is not well informed on the scientific aspect as set out in the report of the Royal Society Food Committee. He is particularly scornful of the view that it is more economical to feed cereals direct to human beings than to use them first for the production of pork. By a travesty of the facts as to the common practice of pig-feeding, and an obvious inaccuracy in the numerical example given, he has no difficulty in evolving his *reductio ad absurdum*. The whole matter would have been scarcely worthy of notice but for the public attack upon the position of the scientific investigator in relation to food problems, and a special meed of thanks is due to Prof. Starling for the swiftness and effectiveness of his defence.

For the farmer the position is perfectly plain and must be faced. The supply of feeding-stuffs is very short, and live-stock of some kind must be sacrificed. Above all, there must be no competition between animals and human beings for food which the latter can directly utilise. It is under this latter head that the hand of restriction falls most heavily on the pig. It is undeniable that by pig-feeding much could be done to remove the evil of the butter-queue; but the bread-queue would be infinitely more dangerous, and can only be avoided by a rigid economy in the use of cereals.

THE INVESTIGATION OF INDUSTRIAL FATIGUE.

PROF. STANLEY KENT gives, in the papers mentioned below,[1] a general summary of the results at which he has arrived in his studies of the physiological signs of industrial fatigue and some practical conclusions to be drawn from them. It is pointed out that the state to be tested is more complex than that of simple muscular exhaustion, inasmuch as it is dependent on a state of the nervous system, brought about, not by muscular fatigue alone, but even more by nervous fatigue, combined with worry, bad hygienic conditions in the factory, ill-health, and insufficient food, as well as unsatisfactory home-life.

The tests used were four in number—reaction time, visual acuity, acuity of hearing, and height of blood-pressure. They were selected as being made quickly and easily, while being incapable of control by the examinee. Curves constructed from the results of these tests show a gradual development of fatigue during the day, which recovers to some extent during the night, so that there is a steady increase through the week. The increase due to overtime work is also indicated, and the greater effect of a given amount of overtime towards the end of the week comes out distinctly. Overtime work always causes a greater fatigue than the same amount of work at an early part of the day.

A factor which upsets the regular accumulation of fatigue is that called by Prof. Kent the "Monday effect." This is due to the lassitude and disinclination to work present on Monday morning. The cause of this appears to be the partial forgetting of skill during the period of rest, and is the more obvious the greater the skill acquired. The decrease of output on the Monday morning is not, in fact, a case of fatigue, but of loss of co-ordination.

As a rule, the Sunday rest puts an end to the accumulated fatigue of the week; if not taken, fatigue continues to increase until breakdown occurs; unless, as usually happens, an automatic slackening of work takes place, accompanied with late arrival in the morning and so on. In any case, there is loss of efficiency.

The measurement of fatigue by tests of the kind described leads thus to the same conclusion as that arrived at by Dr. Vernon from investigations of output, namely, that the maximum output is to be obtained in most cases by reducing the hours of labour. An equally important aspect of the matter is that the worker is also given time for culture and relaxation and for becoming a "reasonable being instead of a mere machine."

It will be seen that the fatigue investigated in this research may be described as the feeling of being tired, as distinguished from the exhaustion of the muscles themselves. Now, it is just here that the mischievous effect of alcohol shows itself so clearly. Alcohol abolishes for a time the feeling of fatigue, and thus enables the worker to go on until the fatigue becomes worse than before. He naturally takes more alcohol and so on. The net result is no increase of output—rather the reverse—while the state of the worker himself goes from bad to worse. The effect of alcohol on muscular work was strikingly shown in the march to the relief of Ladysmith, where the "drinkers" fell out as if labelled. Some interesting results with the four tests mentioned are given on p. 16 of the address on "Fatigue and Alcohol." The reaction-time of abstainers was uniformly less than that of those who took alcohol. Moreover, the depressing effect of a day's work was five times as great in the "alcoholics" as in the abstainers. Similar results were obtained with the other tests.

The conclusion is that the only effect to be put to the credit of alcohol is a psychical one, and that this is transitory, leading to repeated doses. The worker knows by experience that the discomfort called fatigue can be diminished by taking alcohol, and he naturally turns to it. The remedy is obvious. The fatigue is determined by the conditions in which men work. Improve the conditions and fatigue and drinking disappear. Let us, therefore, do our best to provide "the elements of a healthy, full, and interesting life in place of a mere existence without interest, without pleasure, and without hope."

W. M. BAYLISS.

[1] "Fatigue Induced by Labour." *Bristol Medico-Chirurgical Journal*, July, 1917, vol. xxxv., No. 133.
An Address on "Fatigue and Alcohol." Delivered before the Society for the Study of Inebriety. *Lancet*, July 28, 1917.

GERMANY AND IRON-ORE SUPPLIES.

DURING the past year there have been continual references in the German technical Press and in the papers read before various technical societies to the immense importance of the Briey and Longwy iron-ore basins for German industry both during and after the war. Gradually the mask is being dropped in technical circles, where the facts are, of course, well known, and the hollow pretence that this war was a war of self-defence on the part of Germany is barely referred to, for these circles at any rate know that it is a war of aggression and spoliation. In February last Dr. M. Schlenker, Syndic of the Saarbrücken Chamber of Commerce, showed that the extraction of iron ore in the Briey basin amounted (calculated by iron contents) to 28 per cent. of the total German ore supply, this latter being made up as to 56 per cent. of domestic production and as to 44 per cent. of imported iron ore. He said that it must be described as a special stroke of good fortune that at the very commencement of the war Germany came into possession of the Briey ore basin, as without the French iron ores it would have been *impossible* for the German iron industry to cover its enormous requirements of munitions; on the other hand, France has lost, as the result of the operations of the war, 85 per cent. of its pre-war iron output. Dr. Schlenker takes for granted that Germany will retain possession of its spoil and thus remain "simply invulnerable in its most important sources of strength and power."

The same story was repeated even more emphatically at the meeting of the Union of German Iron and Steel Manufacturers at Berlin in December last, where it was pointed out that the German supplies of iron ore in the portion of Lorraine annexed in 1871 will be practically exhausted in forty to fifty years, and that the German iron industry needs the Briey ironfield in order to assure its continued existence. Here, again, the demand for the retention by Germany of the Briey and Longwy iron deposits is most insistently put forward.

Somewhat similar conclusions are reached by the writer of an article signed "Politicus" in the *Fortnightly Review* for the current month. After showing that throughout the history of the world Germany's aggressive militarism has been a constant danger to the world's civilisation, he discusses in detail the main sources of military power—namely, man-power and supplies of coal and iron. He indicates that to a considerable extent the former depends upon the latter, because industrial districts are always the most densely populated, and "the greatest centres of population occur on and around the great coalfields." The writer also emphasises the importance of the iron-ore question, though he employs statistics as old as 1910, and therefore not quite correct in the light of modern knowledge; this accounts for his statement that "Germany has by far the largest iron deposits in Europe. France comes second." Recent developments in France have somewhat altered the position as it was known in 1910, and it is now recognised that the quantity of iron ore in France is but little less, and probably even greater, than that of Germany. This fact, however, strengthens rather than weakens his conclusions, which are that "Germany intends to retain the coal- and iron-bearing frontier lands upon which she has seized. . . . If Germany should be allowed to retain her conquests she would not only subject to herself millions of non-Germans, but she would absolutely dominate Europe with the coal and iron monopoly which the war would have given her, and she would thus be able to embark upon the final conquest of the world."

If any confirmation of the correctness of these views and of the real intentions of Germany is required, this is furnished by the recent speech of the German Chancellor, who gave a number of reasons why Germany should retain possession of Alsace-Lorraine, but carefully abstained from even hinting at their supreme economic importance to Germany.

H. L.

NOTES.

THE managers of the Royal Institution reported at a general meeting of members held on February 4 that Dr. Mond, under the conveyance and deed of trust of the Davy-Faraday Research Laboratory, covenanted to pay to the institution before the year 1926 the sum of 62,000*l.* as endowment fund. Dr. Mond's trustees have in the most generous way anticipated the obligation by eight years, and have transferred the sum of 66,500*l.* in 5 per cent. War Stock to the trustees, nominated by the managers, of the Davy-Faraday Research Laboratory Endowment Fund. This will add materially to the income available for the purpose of promoting and maintaining the efficiency of the Davy-Faraday Research Laboratory in the advancement of original research in chemical and physical science.

A MEETING was held at the rooms of the Royal Society of Arts on Monday, February 4, at the invitation of the London Section of the Society of Chemical Industry, to consider the formation of a London Section of the British Association of Chemists. There was an attendance of about 300, including members of the Society of Chemical Industry, the Chemical Society, the Institute of Chemistry, the Society of Public Analysts, and the British Association of Chemists. Dr. Ling took the chair, and briefly explained the reasons for convening the meeting. Prof. Brame outlined the history of the British Association of Chemists and the course of the negotiations between that body and the Institute of Chemistry. Mr. Smith, on behalf of the British Association of Chemists, dealt with the need for some registration authority for chemists and the demand by chemists for a professional association which would not only improve the status of chemists, but also bring into the ranks of the chemist a larger number of well-equipped men than is now the case. He emphasised the importance of chemists from a national point of view, and invited the meeting to form a London Section of the association. After remarks by Prof. Donnan and other speakers, a resolution was passed, with few dissentients, for the formation of a London Section, and a provisional committee of eleven was appointed to proceed with the matter. Mr. Pilcher made a spirited defence of the Institute of Chemistry against some criticisms of that body, and stated that the institute was not antagonistic to the new association.

THE following arrangements have been made in connection with the Royal College of Physicians of London:—The Harveian oration will be delivered on October 18 by Dr. P. Kidd, and the Bradshaw lecture in November by Dr. Aldren Turner. Prof. H. R. Kenwood is to be the Milroy lecturer this year, and Dr. J. McVail in 1919.

THE next meeting of the Faraday Society will be held at the Municipal School of Technology, Manchester, on February 14, when there will be a general discussion on electric furnaces. The discussion will be preceded by the reading of the following papers:—Application of electric furnace methods to industrial processes, H. Etchells; electric furnaces for steel refining, J. Bibby; electric furnace control, A. P. M. Fleming and F. E. Hill; and a high-temperature electric resistance furnace, E. A. Coad-Pryor and W. Rosenhain.

THE death is announced of Prof. J. P. Remington, chairman of the Committee of Revision of the United States Pharmacopœia and professor of the theory and practice of pharmacy in the Philadelphia College of Pharmacy. Prof. Remington was the author of numerous papers on pharmacy, many of which were contributed to the American Pharmaceutical Association, and of the "Practice of Pharmacy," the sixth edition of which was recently published by Messrs. J. B. Lippincott Co.

THE death of Mr. M. Beazley, which is recorded in the *Engineer* for February 1, is the third death among Indian engineers announced last week. Mr. Beazley was born in Bath in 1833. He assisted Mr. Cubitt in the piercing of the Shakespeare Tunnel at Dover for the South-Eastern Railway. He proceeded to India in 1859, and was engaged in the construction of a portion of the Central Indian Railway. Afterwards he served for ten years in the Imperial Chinese Customs.

WE note with regret that the *Engineer* for February 1 records the death of Mr. T. Anderson on January 15. Mr. Anderson spent about thirty-three years in India, thirty of which were in the service of the Royal Indian Marine. He was born in Greenock in 1842, and went to India in 1864. After occupying various positions, he became, in 1881, engineer-surveyor to the Port of Bombay, and was made chief engineer in 1885. After the Burmese war he was sent to Mandalay to value the factories of King Theebaw. Mr. Anderson was an associate member of the Institution of Civil Engineers.

WE notice with regret the announcement of the deaths of several distinguished medical men. Surg.-Gen. Sir Adam Scott Reid, who died in London on February 2, at the age of sixty-nine, was for many years in the Indian Medical Service.—Sir George H. Philipson, ex-president of the British Medical Association and representative of the University of Durham on the General Medical Council, died on January 24, in his eighty-third year.—Sir James A. Russell, for some years demonstrator of anatomy in the University of Edinburgh, afterwards inspector of anatomy and vivisection for the whole of Scotland, and an active fellow of the Royal Society of Edinburgh, died on January 22, at seventy-two years of age.

THE death has occurred of Prof. Amos P. Brown, professor of mineralogy and geology in the Towne Scientific School of the University of Pennsylvania, at fifty-two years of age. A resolution passed at a recent meeting of the faculty of the Towne Scientific School, and published in *Science*, states that among the most notable recent investigations in America was the work done by Prof. Brown in the field of crystallography; specifically the investigations in the classes of crystals found in the hæmoglobins of the entire range of the vertebrate animals. In the course of this investigation Prof. Brown prepared, examined, and calculated the functions of thousands of intricate and minute crystals, deducing from them conclusions highly important alike to organic and inorganic science. This work, carried out in collaboration with Prof. Reichert, is referred to as one of the greatest contributions to exact science ever made in America.

MAJ.-GEN. H. P. BABBAGE, who died at Cheltenham on January 29, aged ninety-three, inherited much of the mathematical ability of his distinguished father, Charles Babbage, mathematician and mechanician, whose famous calculating machine, after many vicissitudes, was pronounced by a committee of the British Association to be, "in the present state of the design, not more than a theoretical possibility." Maj.-Gen. Babbage was educated at University College School and at University College. He joined the East India Company's Army in 1843, served in Assam and during the Mutiny, and was then transferred to civil employment, where he gained reputation as a builder of bridges. He was a learned mathematician, and is best known by his account of his father's work and of the principles of calculating machines, besides papers on mechanical notation and occulting lights. After his retirement from Indian service he engaged in municipal work at Bromley and Cheltenham, and did good service as a vigilant critic of the accounts of these corporations.

PROF. A. N. TALBOT, professor of municipal and sanitary engineering, University of Illinois, has been elected president of the American Society of Civil Engineers. The American Society of Civil Engineers is the oldest American engineering society. It has a membership of 8225, an annual budget of 30,000*l.*, and assets of 120,000*l.* As a consulting engineer Prof. Talbot has been connected with many large enterprises, such as the Galveston Causeway, the Chicago City Hall, and numerous waterworks and sewage purification problems. Prof. Talbot is a past-president of the Society for the Promotion of Engineering Education and a past-president of the American Society for Testing Materials. The University of Pennsylvania has conferred upon him the honorary degree of Doctor of Science, and the University of Michigan the honorary degree of Doctor of Engineering.

AN interesting example of the audibility of the sound of a distant fog-horn has been communicated to us by Mr. W. T. Evans, of Treharris, Glam. On January 14, from about 6 to 7 a.m., he heard series of four consecutive blasts, each followed by an interval of silence—the distinctive note of the siren at Nash Lighthouse, on the southern coast of Glamorganshire. Treharris is about twenty miles inland, and is separated from the coast by several ranges of hills. Though all the blasts were distinctly audible, they varied in strength, some being as loud and clear as when heard at other times from a distance of four miles. The fog-horn at Nash, according to a statement by the lighthouse-keeper, was sounding on account of a snow-shower from 6.15 to 7 on the morning in question. A thick mantle of snow lay over the ground at the time, and the air was absolutely calm. The conditions were thus favourable for the transmission of the sound to so great a distance.

MR. H. S. WELLCOME has presented to the War Office, for the use of the British Army Medical Department, a completely equipped motor bacteriological laboratory. The body of the car and its extended weather-proof annexe form a laboratory with a total working space of 219 sq. ft. The equipment includes

microscopes, incubators, balance, autoclave, centrifuge, microtome, ice-chest for water samples, and numbers of accessories, the whole being packed in thirteen canteens, which ensures safety in transit under the roughest conditions. A water tank fitted with pump is fixed on the roof of the car, an electric lighting outfit, with dynamo and accumulators, is fitted, and apparatus for the staff mess and sleeping accommodation for the staff are provided. Much ingenuity has been exercised, so that everything is conveniently grouped and easily accessible, and can be packed or unpacked in about two hours. The formal presentation of the laboratory was made a few days ago to Col. Stanistreet, the representative of the War Office.

THE *Times* of February 1 contains an account of an improvement by Dr. S. A. Kapadia in the Lawton method of preserving perishable foodstuffs. In that system the produce was kept under anaerobic conditions, so that putrefactive and other changes were arrested, but the objection to it was that the gas used contained carbon monoxide, forming an explosive mixture in the preserving chamber. The gas used by Dr. Kapadia consists of nitrogen and carbon dioxide, with only a trace of oxygen. Australian apples which had been kept for five weeks in this atmosphere were found to be in as good condition as at first, and the rottenness from some of the specimens had not spread to the neighbouring sound fruit. Raspberries, a fruit very difficult to preserve fresh, after a fortnight of the same treatment were as fresh as when the experiment started, and, moreover, they retained this freshness for four days after removal from the preserving chamber, thus allowing time for the fruit to be marketed. After salted fish had been kept in the preserving chamber for six weeks it appeared to an expert to be in exactly the same condition as when introduced. Similarly, eggs which had been preserved for twenty weeks in the same way could be afterwards boiled without the shell cracking, as if new-laid.

ON account of the warmth and dampness of the air in mines, the timber which is used for props, sleepers, etc., underground is very liable to decay, set up by fungi. Pitwood as a rule lasts a very short time, and has to be speedily replaced. Before the war this class of timber was very cheap, and nothing was done in Britain to lengthen its duration by preservative treatment, although it was known that economies in this direction had been effected in France owing to the experiments that had been undertaken by M. Fayol in the collieries of Commentry, and by Prof. E. Henry in the mines near Nancy. The U.S. Forest Service had also treated a large number of timbers by various methods, and placed them in the coal mines at Pottsville, in Pennsylvania, with convincing results of the efficiency of creosote and zinc chloride as preservatives. Several mining companies in the United States have been using treated timber, and have found it economical. It is most important at the present time to lengthen the life of pitwood in our mines and collieries, as this will result in a lessened demand for seaborne timber. With this end in view, the Department of Scientific and Industrial Research has issued Bulletin No. 1, Memorandum on the Preservation of Timber in Coal Mines, by Prof. Percy Groom. Practical remedial measures against the spread of the spores of the destructive fungi in the galleries are clearly described. The fructifications can be readily removed and burned, provided careful inspection of the timbers is made periodically by an intelligent workman. The mycelia accessible on the surface of the pitwood can be washed off by an antiseptic solution and removed. All the fresh timber put down in the mines should be treated beforehand with creosote or zinc chloride, applied by brushing or impregnated by immersion or pressure methods. When the wood has to last only a relatively short time, other substances may be used, as common salt, magnesium sulphate, and certain mine waters.

A REPORT just issued of the Meteorological Committee for the year ended March 31, 1917, the sixty-second year of the Meteorological Office, shows that considerable activity is maintained in meteorology. Sir Napier Shaw is director, and no change has taken place in the Meteorological Committee constituted under the authority of the Lords Commissioners of H.M. Treasury. The observatories and the stations for the daily weather service have been kept regularly in operation. There has been an unprecedented increase in the work of the forecast division and the instruments division. Many calls have been received for new publications and new editions of existing publications from various sub-departments of the Admiralty, War Office, Air Board, Ministry of Munitions, Board of Trade, and Colonial Office. To meet the increased requirements in the office and to supplement the absence of many members of the staff on military service, use has been made of members of the staff who have reached or passed the age of superannuation in the office. "Summer-time" has entailed some addition to the work, and as the diurnal variations of the weather are so essentially controlled by the sun, the office obtained permission under the Act to retain Greenwich time for the hours of its observations, but this by no means freed the office from much complexity. An interesting inquiry is mentioned, at the instance of Dr. Walker, Director-General of Indian Observatories, into the statistical relation between the weather in the middle of the North Atlantic Ocean and subsequent weather of north-western Europe. Especial mention should be made of an important new work, "Réseau Mondial," for which data have been prepared, which give a compendious review of the meteorology of the globe. This work is a great advance in international meteorology, and the report states that the work is fairly completed for the years 1911, 1912, and 1913.

THE Bihar and Orissa Research Society continues to do excellent work on the antiquities of the province. In the Journal of the society for September last (vol. iii., part 3) Mr. C. W. Anderson describes a find of prehistoric stone implements in the Singhbhum district. The first discovery of such remains dates from 1868. Generally speaking, the trap implements may be classed as Mesolithic, intermediate between the Neolithic and Palæolithic periods. This definition would bring them in line with Prof. Sollas's Azilian stage, if the assumption be made that there was an uninterrupted sequence of industries. But this is by no means a necessary assumption, and such implements as can be compared with European collections rather point to an origin contemporary in the stage of culture, if not in age, with the Magdalenian. If the view recently expressed be correct, that the language of the Kolarian tribes in India may be connected with those of races in the Malayan Peninsula and the Andaman Islands, the present discovery may lead to further interesting identifications.

THE importance of Syria and Palestine as fields for the investigation of prehistoric antiquities is fully illustrated in an important paper by Le Fre Néophytus, entitled "La Préhistoire en Syrie-Palestine," published in *L'Anthropologie*, vol. xxviii., parts 4–5, for July–October, 1917. The practice of human sacrifice in the form of immolation of new-born children in funereal jars is fully established. The historical survey of

explorations describes a large number of prehistoric animals the remains of which have been discovered. The Palæolithic period is represented at several sites in the neighbourhood of Bethlehem and Jerusalem, and the periods known as Mesvinian, Mousterian, Aurignacian, Solutrian, and Magdalenian are all more or less fully illustrated by discoveries. The Neolithic age is abundantly represented by examples from Mount Carmel, the banks of the Jordan, and the neighbourhood of the Dead Sea. The writer remarks that though the prehistoric age in Syria and Palestine has not been so fully investigated as in Europe, the materials for its study are abundant, and students of the history of ancient man will share with him in the hope that when peace has been re-established the study of the remains in this important region will be undertaken with still greater hopes of success.

DR. R. F. SCHARFF, in the *Irish Naturalist* (December, 1917), gives a long and useful history of the now extinct Irish "greyhound-pig," which survived until recently in the more isolated parts of Ireland. This he is inclined to believe is not a descendant of the wild boar which roamed over the island, but was introduced possibly so far back as the Bronze age. It would seem to be nearly related to the ancient "turf-pig" of the Swiss Lake dwellings and the Lake dwellings of Glastonbury, in Somerset. From this last fact it would seem more probable that the Irish pig was introduced from England rather than from the Continent, as Dr. Scharff is inclined to believe. A great deal of information has been brought together in this short paper, which is further illustrated by photographs.

ISLAND faunas afford us valuable data as to the effects of isolation in regard to the evolution of species. Hence we are glad to note the summary of a study of the birds of the Anamba Islands by Mr. Harry C. Oberholser which appears in the Bulletin of the Smithsonian Institution (No. 98). The material described was collected some years ago by Dr. W. L. Abbott, and includes fifteen subspecies peculiar to these islands. As might be expected, they are all of small species of the Passerine type. It is shown that, so far as their avifauna is concerned, these islands are most closely related to the Malay Peninsula, less so, but about equally, to Sumatra and Borneo, and only slightly to Indo-China.

A VERY remarkable shrew, *Scutisorex congicus*, is described by Mr. J. A. Allen in the Bulletin of the American Museum of Natural History (vol. xxxvii., 1917). This animal, when originally described by Mr. Oldfield Thomas from a skin and skull from Uganda, seemed to differ from the typical shrews chiefly in its long, thick fur and the great development of the cranial ridges. But a number of specimens have been recently obtained by the American Museum of Natural History Congo Expedition, and among these are several skeletons and specimens in alcohol. The dissection of these has revealed a quite extraordinary condition of the vertebral column, unknown in any other mammal. Briefly, all the vertebræ, from the seventh thoracic to the last lumbar, have the latero-ventral borders so enormously produced that this part of the vertebral column, seen from below, is deeply trough-shaped. Nothing that is known of the habits of this creature affords any explanation of so singular a modification. But it certainly imparts tremendous strength to the backbone. This is well known to the natives, who take "great delight in showing to the easily fascinated crowd its extraordinary resistance to weight and pressure . . . a full-grown man weighing some 160 lb. steps barefooted upon the shrew. Steadily trying to balance himself upon one leg, he continues to vociferate several minutes. The poor creature seems certainly doomed. But as soon as his tormentor steps off, the shrew, after a few shuddering movements, tries to escape, none the worse for this mad experience." Having regard to the fact that fully adult animals do not exceed 243 mm. in length, its weight-carrying possibilities are truly wonderful. The natives hold this animal in great esteem. They are convinced that its charred body, or even its heart, when prepared by their medicine-men, transmits truly invincible qualities. Such precious relics are always worn by those engaging in warfare, or setting out on any equally dangerous enterprise, such as hunting elephants.

THE December number of *Terrestrial Magnetism and Atmospheric Electricity* contains an article by Mr. J. P. Ault on the meteorological observations taken by the *Carnegie* during her voyage around the Antarctic continent in the spring of 1916. With a few exceptions, the observations were taken between latitudes 50° and 60° S. from Lyttelton, New Zealand, to South Georgia, Kerguelen, and Lyttelton. The temperature of the sea, the pressure, temperature, and humidity of the air, the direction and speed of the wind, and the position of the ship are given for noon each day. The weather was uniformly bad, the humidity 80 to 90 per cent., the sea and air temperatures only a few degrees above freezing point, and the wind high. With decreasing barometric pressure the wind almost invariably shifted from north to west, became a gale, and as the pressure again increased, shifted to the south-west and blew hard. A comparison of the *Carnegie* observations with those made by the Shackleton expedition during the same period should prove of considerable interest.

THE *Chemical Trade Journal* for December 29 contains an interesting article on the perchlorate method of estimating potassium. By the work described the following facts are established:—(1) The perchlorates of sodium, barium, calcium, and magnesium are readily soluble in alcohol containing 0·2 per cent. of perchloric acid, in which potassium perchlorate is almost insoluble. (2) The chlorides of the above metals are completely transformed into perchlorates by evaporating their solutions with excess of perchloric acid. (3) The loss effected by washing one gram of potassium chlorate with 100 c.c. of alcohol containing 0·2 per cent. of perchloric acid and then with 2 c.c. of alcohol amounts to 0·36 per cent. (4) Barium hydroxide is preferable to barium chloride for the preliminary precipitation of sulphates, and, when such large quantities as 0·8 to 1·0 gram of perchlorate are dealt with, it is advisable to use the solid hydroxide. The procedure recommended is as follows:—The solution of the potassium salt is treated with excess of solid barium hydroxide, and the barium sulphate filtered and washed under pressure on an asbestos filter. The filtrate and washings are evaporated with a 50 per cent. excess of perchloric acid in a glass basin until white fumes are evolved, then 25 c.c. of water are added, and the product evaporated to dryness. The residue is taken up with 20 c.c. of alcohol containing 0·2 per cent. of perchloric acid, the potassium perchlorate transferred to an asbestos filter, washed with 80 c.c. of the dilute alcoholic solution of perchloric acid, and then with 2 c.c. of pure alcohol. The filter is dried, weighed, washed with boiling water, dried, and again weighed, the difference in the two weights giving the amount of perchlorate. It does not seem to have occurred to the writer to use a Gooch crucible, and thus reduce the weighings to one, nor does he seem to

be aware of the work of W. A. Davis (Nature, 1912, vol. xc., p. 441), who established most of the above facts, and in addition showed that the loss of potassium perchlorate can be entirely obviated by washing with alcohol saturated with this salt.

Mr. Robinson Smith, in an article on efficiency in the *Quarterly Review*, states that the two forces in America that in recent years have done most to put the American house in order, and of which next to nothing is known in Europe, are efficiency and prohibition. Efficiency, or scientific management, as it was termed by its founder, was introduced by Mr. F. W. Taylor, and its methods certainly lead to large increases in the output per worker. Mr. Taylor got his data by timing men at work with a stop-watch, and by seeing whether the men could do more work if they omitted certain movements or rested periodically; hence the term "motion-study." The following illustrates the process applied to a gang of men lifting pig-iron from a ground-pile, walking up an inclined plank, and dropping it into a car at the rate of 12½ long tons per day. "Taylor's first step was to single out one of these men—of the ox-type of man—and on this first day and all day long he was told by the man who stood over him with a watch: 'Now pick up a pig and walk'; 'Now sit down and rest,' and at half-past five in the afternoon the man had loaded 47½ tons of pig-iron on to the car." The author of the article expresses regret at the cold reception which has been given to Mr. Taylor's ideas in Britain, and uses many arguments in its favour. Probably the prejudices which bar the way at present would be modified considerably if workmen were convinced that better wages and shorter working hours would permanently follow the introduction of Mr. Taylor's methods.

Some recent developments in balancing apparatus are described in a paper read by Mr. N. W. Akimoff before the American Society of Mechanical Engineers and reprinted in *Engineering* for February 1. Mr. Akimoff's original machine consisted in principle in mounting the body which required dynamic balance on a beam hinged at one end and supported on a spring at the other. A "balancing cage" was also mounted on the beam and rotated in unison with the body. By moving masses on the balancing cage, the effect of the rocking couple on the body was neutralised, and from a knowledge of the amount and position of these masses was obtained the information necessary to correct the want of balance in the body. In Mr. Akimoff's latest machine the effects of both static and dynamic want of balance can be readily neutralised by means of a clamp fixed to the body, and having a mass which can be adjusted in radius from the axis of rotation. The clamp can be moved axially and also adjusted for angular position. The effect of static want of balance is first eliminated, and the rocking couple is then got rid of. The machine is ingenious, and appears to be effective in solving a rather troublesome problem.

The water supply of the city of Brisbane is the subject of an article in the issue of the *Engineer* for January 25, and the following particulars are of interest. The supply is derived chiefly from the Brisbane River. The pumping plant, which is located about twenty miles from the city, and above the tidal region, consists of three triple-expansion, condensing engines, each capable of pumping six million gallons per twenty-four hours. The population supplied is about 158,000, and the average daily consumption forty-six gallons per head. There is an important storage reservoir at Cabbage Tree Creek, a tributary of the Brisbane River, formed by a dam of cyclopean concrete, 740 ft. long (including the by-wash), 125 ft. high, 95 ft. thick at the base, and 10 ft. wide at the top. The surface area of the enclosed lake is 700 acres, and the quantity of water impounded 5,800,000,000 gallons. The rainfall of the district is intermittent; there are long periods of drought alternating with heavy downfalls, which result in floods. The longest recorded period of drought was in 1915, when the Brisbane River was dry for eight weeks. Allowing for evaporation, the available quantity of water, when the reservoir is full, affords 12,000,000 gallons daily for 300 days, and as the present consumption is only seven and three-quarter million gallons per day, there is ample margin for considerably more than a year's supply without the aid of a single drop of rainfall. The dam was ceremonially opened in December, 1916, the work having cost about 172,000*l*.

The latest catalogue of second-hand books (No. 172) just issued by Messrs. W. Heffer and Sons, Ltd., Cambridge, should be of much interest to readers of Nature, seeing that it deals mainly with books relating to science. It contains sections devoted to astronomy and meteorology, botany (including forestry and herbal), chemistry, folklore and mythology, geology, mineralogy and palæontology, mathematics, physics and engineering, physiology, anatomy and medicine, and zoology, biology and Nature-study. Copies of the catalogue are obtainable upon application.

OUR ASTRONOMICAL COLUMN.

Luminosities and Parallaxes of 500 Stars.—The spectroscopic method of determining the absolute magnitudes, and thence the luminosities and parallaxes, of stars has been further improved in detail by Messrs. W. Adams and A. H. Joy, and applied to 500 stars (*Astrophysical Journal*, vol. xlvi., p. 313). For stars of the same spectral type, the enhanced lines and the hydrogen lines are relatively strong in those of high luminosity, and weak in those of low luminosity, while the low-temperature lines behave in a manner directly opposite. For 360 of the stars, measured parallaxes are available for comparison, and the average difference between these and the spectroscopic parallaxes, taken without regard to sign, is 0·026″. The spectral types now within the capacity of the spectroscopic method range from A8 to M. One of the most striking conclusions from this important investigation is that the distinction between "giant" and "dwarf" stars is clearly shown for types M, K, and G, with a slight indication of such separation even in the case of F stars. In the case of the M type the list includes thirty stars brighter than absolute magnitude 3·9, and twelve stars fainter than absolute magnitude 9·5, with none of intermediate brightness. It is considered almost certain, in the case of types M and K at least, that these results cannot be ascribed to the selection of the stars. The catalogue is conveniently arranged, and includes position, proper motion, and visual magnitude, besides other data.

Solar Hydrogen Bombs.—A remarkable solar phenomenon of short duration has been investigated photographically and visually by Mr. F. Ellerman at the Mt. Wilson Observatory (*Astrophysical Journal*, vol. xlvi., p. 298). It consists of the sudden appearance of a very brilliant narrow band extending for several angstroms on each side of Hα, which persists as a dark line with little change in width. The duration is only from one to three minutes on the average, and rarely from five to ten minutes. The average width of the bright band is about 8 A., but in an extreme case the band extended over 30 A. These "bombs"

are most likely to appear around and among active spot-groups, especially groups which are developing and have many component members. At times they follow one another like the balls of a Roman candle, at intervals varying from ten to twenty minutes. Two essential conditions for their observation are good seeing and a large solar image. The appearance suggests something of the nature of an explosion, in which nothing but hydrogen seems to be involved. The level at which the explosions occur would seem to lie below the reversing layer, as the Fraunhofer lines, including those of hydrogen, do not seem to be affected. The phenomenon is quite distinct from the ordinary eruptive reversals of Hα, in which the continuity of the dark line is interrupted.

"ANNUAIRE DU BUREAU DES LONGITUDES."—In addition to the valuable astronomical tables and explanatory matter which ordinarily appear in this well-known official publication, the volume for 1918 includes a number of articles of special interest. Among these is the first part of an extensive study of sundials by M. Bigourdan; the Egyptian calendar, by the same author; the sun and terrestrial magnetism, by M. Hamy; and the life and work of Gaston Darboux, by M. Emile Picard. It should be noted that the tabular matter is not exclusively astronomical, but also includes authoritative data which make the volume a valuable source of reference on questions relating to meteorology, terrestrial magnetism, physics, and chemistry. The *Annuaire* is published at two francs by Messrs. Gauthier-Villars et Cie.

THIRD MELBOURNE STAR CATALOGUE.—The third Melbourne General Catalogue of 3068 stars, for the equinox 1890, has recently been issued. It is based upon observations made at the Melbourne Observatory during the period 1884 to 1894, under the direction of Mr. R. J. Ellery, and has been prepared for publication by the present Government Astronomer, Mr. P. Baracchi. The catalogue includes fundamental stars used for the determination of clock-error and azimuth, guide-stars in connection with the astrographic work, and various stars observed for special purposes at the request of other astronomers. The second catalogue, of 1211 stars, was published in 1889.

THE ENDOWMENT OF UNIVERSITY AND TECHNICAL EDUCATION.

MR. H. A. L. FISHER, President of the Board of Education, speaking at Birmingham on January 31, referred to the support afforded to higher education in the United States and Germany in comparison with that in England. He is reported by the *Times* to have said that "he had been looking into the endowments from private sources which have been going to the American universities on one hand, and to the English universities on the other, in recent years. In the period from 1906 to 1917 the American universities received an average of more than four millions annually from private sources, whereas our universities were lucky if they received 200,000*l.* in one year. Concerning the amount of State help to the universities in Prussia on one hand, and in England and Wales on the other, whereas the Prussian universities receive rather more than a million pounds a year, our universities and technical institutes receive 378,000*l.* from the rates and taxes combined. The comparison is even more unfair to England than it appears at first sight, because the Prussian figures exclude the endowments of the technical institutions and sums paid by the State to assist the training of teachers."

We are glad that Mr. Fisher has directed attention to the need for more liberal provision for university and higher technical education in this country, as indicated by the support offered in other countries. The most complete survey of State-aid and private endowments for scientific and educational purposes is that given annually in the report of the British Science Guild; and in connection with Mr. Fisher's remarks it is of interest to extract the following facts from such reports published in recent years:—

(1) The grand total of gifts to education in the United States during the forty-four years 1871–1914 was 116,883,600*l.* The average annual amount of new benefactions during the four years 1911–14 was six million pounds, excluding grants by the United States, different States, and municipalities; in the United Kingdom, the average is less than one-twentieth this amount.

(2) The total receipts of universities in the United States in the year 1910–11 amounted to nearly nineteen million pounds, and the benefactions to five millions. In the same financial year, the total incomes of those universities and university colleges in Great Britain which are in receipt of State grants was little more than one-seventh of the amount of gifts to education in the States, and was less than one-thirtieth of the incomes of the universities there.

(3) The income from endowments in the case of the universities and university colleges receiving Treasury grants is about 85,000*l.* for England and 4000*l.* for Wales; or, say, 90,000*l.* for Great Britain. Five universities in the United States have each a much greater income from private endowment funds alone than the total endowment income of State-aided universities and university colleges in Great Britain. They are:—Harvard University, 239,500*l.*; Columbia University, 199,700*l.*; Leland Stanford Junior University, 177,400*l.*; University of Chicago, 164,700*l.*; and Yale University, 140,900*l.*

(4) Our Treasury grants in aid of expenses of universities and university colleges amount to about 300,000*l.* The Treasury grants of the United States Government to universities and colleges amount to 1,175,000*l.*, and the State or city grants for current expenses to 2,940,000*l.*, or more than 4,000,000*l.* in all. The contributions of several single States in the United States, from State or city funds, for current expenses of universities and other institutions of higher education approach the total amount of the grant made for like purposes in Great Britain.

(5) In Germany, State subsidies provide the main part of the incomes of the universities. The annual expenditure for the universities from State funds amounts in round figures to 1,800,000*l.* In 1913 the expenditure of the University of Berlin alone was 242,000*l.*; and of this amount 200,000*l.*, or about 83 per cent., was derived from State funds.

(6) The total number of full-time day students in the universities of the United Kingdom is about 21,000, in comparison with 55,000 in German universities. In our technical institutions, the number of day students in attendance is about 2000, in comparison with 16,000 in the technical high schools of Germany. The seventy-two universities, colleges, and technical schools in the United States, on the accepted list of the Carnegie Foundation for the Advancement of Teaching, had, in 1910, 89,000 students.

It is evident that we have much leeway to make up in order to increase the number of highly trained men required to enable us to come into line with the United States and Germany as regards the provision for the scientific development of our industries. There is no more important problem of reconstruction than that of extending our facilities for higher education, yet almost nothing has been done to enable our universities and technical institutions to provide for the extensions which are needed for national security in the future.

As we have now a really democratic President of the Board of Education, who has a genuine zeal for education and a fervent desire that all who are capable of benefiting from it shall have the means of enjoying its advantages, we may hope that steps will be taken to place our universities and technical institutions upon a satisfactory financial footing. In an address delivered in September last to the Associated Educational Societies of Manchester, on "Educational Reform," recently issued in pamphlet form, Mr. Fisher surveyed the whole field of education, and directed attention to the great increase in the number of universities now existing in England and Wales, comprising twelve, including the ancient universities of Oxford and Cambridge. Mr. Fisher characterised these as in the forefront of European learning, and said they need not fear comparison with the most famous universities of the Continent in respect either of the quality of their contributions to the advance of knowledge or of the adequacy and power of their teaching. The ten more modern universities, which are largely subsidised by the State, have not yet received an equipment at all adequate to modern needs, and are nowhere supported by so large a body of students as they deserve. Attention was directed to a comparison between Lancashire and Scotland, with a similar population. In the former there are two universities, in the latter five, with, in the case of Scotland, a body of undergraduates five times as numerous as that of the Universities of Manchester and Liverpool combined.

The place and function of the secondary school in its relation to the university were also discussed by Mr. Fisher. While the number of such schools has greatly increased, there being nearly 1000 in receipt of education grants, there is in many areas very inadequate provision, to the great detriment of the children residing therein. There are too many early leavers and too low a percentage of pupils who reach matriculation standard. Much needs to be done before the secondary schools can reach a proper level. Better salaries must be offered to the teachers and an adequate scale of pensions arranged. More encouragement must be offered to induce a higher standard of work, and so enable the universities to reach a higher plane of teaching. More and better provision is needed in the way of maintenance scholarships enabling capable, though poor, children to travel along the broad highway unimpeded from the elementary school to the university. Whilst the work of the elementary school has much improved of late it can never do its full work until the leaving age is made compulsory up to fourteen at least, and provision then made for a liberal, continued education within working hours for those entering industry up to eighteen years of age.

One point which has been overlooked in recent discussions is that of the need for improvement of the scales of salaries of teachers in universities and technical institutions if competent instructors are to be maintained. A meeting of teachers engaged in the technical institutes, junior technical and trades schools of London and the neighbouring counties was held on Saturday last to consider this question. Special emphasis was laid by several speakers on the fact that men and women of attainments similar to those of teachers in technical institutions can obtain much higher salaries in industry or in secondary schools than are paid in the technical institutions. A resolution declaring that the present rates of salaries paid to both day and evening teachers in technical institutions are totally inadequate, and urging the education authorities to take immediate steps to establish satisfactory scales of salaries for all teachers, was carried unanimously. A further resolution requesting the Government to allocate special grants, similar to those given in the case of secondary and elementary schools, for improving the salaries of teachers in technical institutions was also adopted. It was agreed that the London Branch of the Association of Teachers in Technical Institutions, by whom the meeting was organised, should request the County Councils of London and the Home Counties to receive deputations for the purpose of placing the views of the meeting before them.

MAGNETIC SURVEY OF NEW ZEALAND.[1]

IN the observational work recorded in the publication referred to below Dr. Farr had much assistance from Mr. Skey, who succeeded him as director of the Christchurch Magnetic Observatory when Dr. Farr became professor of physics at Canterbury College, while Mr. D. B. MacLeod took an active part in the discussion of results. The observational work extended over the years 1899 to 1909, in the course of which 334 stations were occupied, including forty-four in the Southern Islands, Chathams, and West Coast Sounds. The instruments, a unifilar magnetometer and dip circle—the former once used by the North American Boundary Commission, and by the Jackson-Harmsworth Polar Expedition—were lent by the old Kew Committee of the Royal Society.

Particulars are given of the position of each station, the date or dates of observation, the values of the declination, dip, east and north components, horizontal, vertical, and total forces. Owing to the long period covered by the observations, considerable importance attaches to the secular change corrections necessary to reduce the data to a common epoch. These were based on the magnetograph data obtained at Christchurch from 1901 onwards, and on observations at repeat stations. Following the example afforded by Rücker and Thorpe's survey of the British Isles, New Zealand was divided into ten overlapping districts. These were bounded by parallels of latitude, the limits of three successive ones being, for instance, 38° and 40° S., 39° and 41° S., and 40° and 42° S. Assuming the change in any element within any one district a linear function of the latitude and longitude, the rates of change with latitude and longitude were deduced in the first instance by the method of least squares. A process of smoothing was then applied, to secure continuity in passing from one district to the next.

The general nature of the results is best seen by consulting the maps. The great length of New Zealand from north to south necessitates two maps for each element, one for the North Island, the other for the South Island. The latter, it should be noticed, is described as the "Middle Island" in the charts principally devoted to the North Island, a memory of the time when the small island, now known as Stewart Island, was called the South Island. In the case of the declination, starting at the extreme north of the North Island, we have the isogonal of 14° 0′ E., sloping from N.W. to S.E. Near the south of the North Island, and north of the South Island, the isogonal of 15° 50′ runs nearly due east and west, while to the extreme south of the South Island the isogonal of 17° 10′ slopes from N.E. to S.W. The isoclinals and lines of equal horizontal force, on the other hand, have a nearly parallel trend from extreme north to south. The dip ranges from under 60° S. to over 71° S., and the horizontal force from 0·275 C.G.S. in the extreme north to 0·200 C.G.S. in Stewart Island.

Other maps deal with the northerly, east, and vertical components, and the total force. The two last

[1] "A Magnetic Survey of the Dominion of New Zealand and Some of the Outlying Islands for the Epoch June 30, 1903." By Dr. C. Coleridge Farr. Pp. 64+2, with 18 maps. (Wellington: John Mackay, Government Printer, 1916.)

show the local disturbing forces, which are discussed in pp. 28–31. Amongst the largest disturbances are those in Stewart Island and near Invercargill and Dunedin. Prof. Marshall contributes in pp. 63–64 some remarks on the geological character of the disturbed regions. His conclusion is that "while in each case of magnetic irregularity it is possible to point to some unusual geological feature, these are in no instance the most marked feature of that kind in the country, and those localities where such feature is most pronounced show no unusual magnetic characters." As Dr. Farr says himself, there is room for considerable further observational work in the disturbed districts.

Two supplementary pages give particulars of observations made in March and April, 1916, at ten of Dr. Farr's stations by Mr. W. C. Parkinson, once of Greenwich and Eskdalemuir Observatories, now observing for the Carnegie Institution of Washington. These serve a useful purpose in showing the changes that have occurred since the epoch of the survey.

Transport is still a serious difficulty in parts of New Zealand, and the work had to be carried on in the spare time which his other important duties left at Dr. Farr's disposal. He is to be congratulated on having brought to a satisfactory conclusion an arduous piece of work, which adds substantially to our knowledge of terrestrial magnetism in the southern hemisphere. It is satisfactory to notice that the work had the active support of the New Zealand Government, and that the printing was done, and satisfactorily done, at the Government Press. C. CHREE.

PARASITES OF CROPS AND CATTLE.

VERY striking data as to the extent of the loss of crops occasioned by diseases of parasitic origin are contained in the paper on economic mycology read by Prof. M. C. Potter at the Newcastle meeting of the British Association (1916), and since published in the Journal of the Royal Horticultural Society (vol. xlii., parts ii. and iii.). In the year 1891 the loss to the German Empire upon the total cereal crops was estimated at more than 20 millions sterling, an amount nearly equal to one-third of the total value of the crop. In the same season (1890–91) the loss due to rust of wheat in Australia was estimated at 2½ millions. The case of potatoes is even more notorious. In Germany the loss due to disease of the potato crop amounted in one year to 30 millions, and in our own country it is computed that, on the average, the crop is reduced by disease by at least one-third. It is estimated that in Northumberland and Durham about half the crop of swedes and turnips is destroyed in average years by parasite attacks. Losses of timber also are very serious, and probably amount to one-third of the whole. Other crops, such as tea, rubber, hops, and every kind of fruit, greenhouse, and garden crops, all pay a heavy toll to fungus diseases. A plea is entered for greater encouragement by botanists to the prosecution of research in phyto-pathology and for the wider treatment of the fungi in ordinary botanical courses, especially from the point of view of their work in Nature. The scope of the problems awaiting solution in this field is abundantly illustrated, and appreciation is expressed of the increased attention and support given to it in recent years by Government departments and other institutions, although further provision is still urgently necessary.

A report on investigations into the cause of worm nodules (*Onchocerca gibsoni*) in cattle by Messrs. C. G. Dickinson and G. F. Hill has been issued as a Bulletin (C. 9341) by the Government of the Commonwealth of Australia. Two series of experiments were carried out in the Northern Territory with calves from nodule-free districts of Victoria. Calves grazing on high, dry ground along with infected cattle became infected within eight months of arrival, whereas similar nodule-free calves did not become infected during the same period when enclosed in an open pen with concrete floor within 30 yards of a paddock within which affected cattle were depastured, although exposed to the attacks of winged and apterous Arthropoda. The results, while not revealing an intermediary host of the parasite causing Onchocerciasis in cattle, have definitely excluded certain species that were regarded as possible vectors, namely, *Lyperosia exigua, Stomoxys calcitrans, Tabanus mastersi, T. nigritarsis, Boophilus australis,* and any purely aquatic forms other than those possibly found in the bore-water. Various common species of mosquito, it is thought, may also be excluded. Wild swamp buffaloes were not affected, whereas wild Zebu cattle and domestic cattle grazing on the same country are invariably affected.

LIGHT AND VISION.[1]

THE old Greek philosophers who did so much thinking and so little experimenting had queer ideas about light and vision. Empedokles, who died about 420 B.C., considered it necessary to record the fact that darkness is not a real thing, but privation of light; and that the moon shines with reflected light, but he thought that the sun is the primary fire of the light of the sky reflected in a crystalline spheroid. Democritus, who died about 370 B.C., held that vision was to be explained by emanations or exceedingly thin husks or films which were continually being detached or thrown off from the surface of bodies, and that they penetrated into the sense-organs through fine passages or pores. We admit this in the case of taste and of smell. These ghost-like forms or images were called *eidola* (εἴδωλα), whence we have the word idol (a very different kind of image from those considered in optical books), and were supposed to be ever passing from the object to the moist and receptive surface of the eye straight into the mind. Aristotle, who died about 325 B.C., seems to have objected to some of the earlier theories. He scarcely alludes to light and vision in "De Physica," but there is some reason to suppose that a treatise by him on optics has been lost. More than two centuries later Lucretius, the scientific poet, discussed the theory at great length in the fourth book of "De Natura Rerum." He used the expression *simulacra quasi membranae*, resemblances like films, peeled off from the upper surface of things, flying hither and thither on one side and the other through the air. *Simulacra* was also used for ghosts, and he goes on to explain how they terrify us in sleep. He also attempted to explain the action of curved mirrors, of the distance of the image behind a mirror, and why the theory does not work in the dark.

The schoolmen in the Middle Ages tried to follow Aristotle as closely as they could, but matter and form probably did not mean to them what they meant to Aristotle or to us. The *eidolon* was still used, but the expression had lost its materialistic signification. At the end of the sixteenth century men began to shake off dogmas of authority, to think for themselves, and to follow inductive lines of reasoning.

We may perhaps flatter ourselves that in our branch of applied optics we are not trammelled by fundamental theory, and that if the corpuscular hypothesis of light came back again into fashion next week to replace the undulatory theory, as the electron has pushed aside the

[1] From the presidential address delivered before the Illuminating Engineering Society on December 18, 1917, by A. P. Trotter.

elastic ether hypothesis which satisfied us in Maxwell's days, we should carry on with no change in our methods.

Silvanus Thompson, in his inaugural presidential address on the founding of our society, referred to the youthfulness of that branch of engineering which we practise. It recalled, he said, illuminations on the proclamation of peace after the Crimean War. "Bengal lights and rockets. How the vision of them stands out in memory! But our society has as little to do with fireworks as with fireflies. As little—and as much—for, after all, both of them are assuredly of some interest to the illuminating engineer."

He knew that the secret of the firefly is still hidden from us, but that if we knew it, if we knew how to produce the rapid vibrations which give the stimulus called light, without producing all the slow ones as well, as when we sound a high note with a finger instead of pressing all the keyboard at once, the mechanical equivalent of light would be as important as the mechanical equivalent of heat, and we should be able to produce light without heat. The quantity of energy which appears as useful light is about 2 per cent. of the energy radiated from an electric glow-lamp; in the firefly it is about 96 or 97 per cent. In other words, if we could produce a highly efficient lamp, the light-generating output of a dynamo would be fifty times greater than now, and 45 lb. of coal would do what a ton does to-day. The cost of lighting will not be reduced in anything like the same proportion. The cost of fuel is about one-tenth of the selling price of the light. The ordinary London householder pays 3*d*. to 6*d*. for his domestic lighting, which entailed a consumption of about 0·44*d*. of coal at pre-war prices.

While so many engineers and scientific men have been eager to do something for the war, and so few have succeeded in finding any appreciation of their services, our society must be content to have been allowed to carry out more than one investigation for which it was well fitted. Silvanus Thompson said that fireworks, as well as fireflies, were of some interest to the illuminating engineer. The star-shell, flares, and parachute lights which play so important a part in the war are but fireworks. The chemist has used his skill to choose the most suitable compositions, and ingenuity has been expended in putting them up and in priming them; but in estimating the results, no further progress had been made beyond the stage of Lambert—the eye alone was the judge. Fortunately the right men in the right department were approached. It was recognised that photometric tests would be useful. Our society offered to find men who would suggest methods and give their time, if necessary, to carry out the work. A committee was accordingly formed; it conferred with the experts, who cordially placed their data and requirements before the members; a special photometer was at once discussed, designed, and made. At the present time nothing more can be said than that the instrument has fulfilled all expectations; it needs no manipulation whatever during observations, measurements may be taken over large ranges, and the behaviour of unsteady or flickering lights can be recorded. The observations on a large number of samples, both of service patterns and of experimental kinds, were made by the committee during night meetings, and were reduced to candle-power-seconds per gram of composition, and it is hoped that the results have been useful.

Some five and twenty years ago it seemed likely that luminous paint would have many useful applications, but the results were disappointing. The preparation of one of the best kinds was kept secret, and it was never properly placed on the market. Night operations of war have directed attention to this subject, and the old method of exciting zinc sulphide or other materials by light has given place to continuous stimulation by α rays of radium compounds. Dials of watches and compasses are well known, and luminous gun-sights are no secret, but there are other applications which cannot be described at present. On these a committee of our members has been working. Tiny tubes are used which are smaller and give less light than a glow-worm, but in their preparation careful photometric measurements of considerable difficulty have been made and valuable information has resulted from the research.

More work is wanted, or at all events more accessible literature is needed, on the physiology of vision. The dioptrics of the eye are well understood; its normal, abnormal, and pathological characteristics are the basis of ophthalmic science. The theory of colour vision is still, perhaps, unsettled, though no one worker will admit it. The subject to which I wish to refer is a purely quantitative one, and is the relation of light flux to visual perception. The range of the luminous stimulus to which the eye can respond is enormous. When we grope our way on so dark a night that objects are only just visible, the illumination is about one-ten-thousandth of a foot-candle, or equal to that received from a candle at a distance of 100 ft. In summer sunshine we often have 5000 foot-candles, and in clearer atmospheres than ours 10,000 foot-candles are reached. The brightness of a furnace is even higher, and furnace-men judge the temperature by the colour.

By some marvellous organic control the eye so reacts that it is capable of estimating difference of tone and colour over a range of several thousand millions. The contraction of the pupil has very little to do with this regulation. It merely seems to take advantage of a greater stimulation to reduce spherical aberration. Over a large part of the enormous range Fechner's relation between stimulus difference and sensation difference holds good. There must be some intricate and delicate provision, perhaps, of a chemical change in the receptive portion of the eye, the retina, depending on saturation or exhaustion of material; or some inhibition of the transmissive portion, the optic nerve, or some compensatory reaction or opposing activity or fatigue in what Huxley called the sensificatory portion, the brain. The automatic adjustment of control which permits so sensitive an organ to accommodate itself to such great changes in the external stimulus has its counterpart in other organs and functional mechanisms of the body, such as those which are concerned in breathing. If physiologists could tell us something about this quantitative control, it would help us in several ways.

SCIENCE AND THE COLD-STORAGE INDUSTRY.[1]

THE value of perishable produce imported into this country, subject more or less to refrigeration, was, before the war, about 130,000,000*l*. per annum. It is abundantly evident that the most natural means of preserving foodstuffs, viz. by methods of low temperatures, have gained the confidence of our merchants, and the cold-storage industry to-day is a striking example of the successful combination of science, commerce, and industry. The history of the cold-storage movement reveals four outstanding features:—

(1) It is difficult to imagine a more striking example than the cold-storage industry affords of the success of the spirit of enterprise and love of adventure which have always characterised British commerce.

[1] From a paper read before the Royal Society of Arts on December 19, 1917, by Prof. J. Wemyss Anderson.

(2) Refrigerating engineers have been in no sense less typical, inasmuch as the methods employed are scientifically sound, the machines of the leading manufacturers are thoroughly trustworthy, and the necessary low temperatures for the transport and storage of food have been made a sound commercial proposition.

(3) Refrigeration has played a most important part in the development of some of our Colonies—particularly Australia and New Zealand.

(4) While the applied science of the engineer has done much for the advance of cold storage, pure science has in this country done little or nothing for the commercial preservation of foodstuffs.

The principal foodstuffs at present cold-stored can be roughly divided into three classes:—

(1) Produce the life-history of which is finished, such as all classes of meats, poultry, rabbits, and fish.

(2) Produce the life-history of which is not finished, such as fruit and eggs.

(3) Milk and produce from milk—cream, butter, and cheese.

It has been found that with good rearing of sound stock, combined with scientific methods of slaughter, and a thorough system of veterinary inspection and hygienic after-care, beef can be kept in the chilled (soft or unfrozen) state for five or six weeks. This time permits of a voyage from North or South America, together with the time necessary for collecting the cargo at one end and its distribution at the other—in this country. This time allowance cuts out all possibilities of a chilled beef trade with Australia or New Zealand with low temperatures only.

Then, with all classes of meats, poultry, and rabbits, certain troubles manifest themselves from time to time —such as mould. Often the troubles are epidemic and caused by ignorance or carelessness prior to shipping, while often only a small percentage of an overseas consignment is affected and the source of trouble cannot be found by the trader.

Fish has been preserved in many ways, but it is safe to say that refrigeration is destined to outrival, in bulk, all other methods. Research work is urgently needed in this direction, both with respect to meeting periods of glut and for general preservation and transport. The main questions to be determined are:—

(1) What kinds of fish will stand preservation the best?

(2) What are good methods, and, if possible, the best with each kind of fish?

(3) Which seasons of the year are the best adapted for each form of preservation?

(4) What are the food values and general effect for each method of preservation on the principal kinds of fish?

When the best methods have been determined, there still remains the problem of educating the public taste. In the British Isles the problem is mainly how to get the fish to the markets in a fresh state. Cold-storage methods will help this, but wider researches are required for the fishermen who go far to sea, and also for fish imported in a frozen state from our Colonies.

The preservation of both fruit and eggs, if properly understood, would mean a great saving of wealth to the country, and also better health. It seems very doubtful if new-laid eggs will ever again be sold in any part of the country at 6*d.* a dozen. With respect to fruit, refrigeration has enabled this country to enjoy a perpetual autumn; but the methods that enable Australian fruit to be eaten in a sound condition in this country are not applied to home-grown fruit. Why? The fruit merchants of this country have had to depend on the pure science of countries other than our own to help them to keep material the life-history of which is not finished. Fruit and vegetables offer an immense field for research.

Milk and its products open up a still greater field. Sterilisation as usually adopted hopelessly destroys its structure, and, no doubt, correspondingly destroys its food value. Common-sense deductions point to mechanical milking into covered vessels, the whole to be cooled down to 3° or 4° C. as soon as possible after the milking operation, and then kept away from the air until the time of consumption. Milk so treated and kept cold will keep quite sound, with ordinary commercial handling, for more than a week—theoretically, it should last for months.

The main questions may now well be asked: What has stood in the way of scientific development in the past, and what are the suggestions for the future?

With respect to low-temperature work, the answer to the first question can be readily divided into two main reasons:—

(1) The want of a bond or link between pure science and industry.

The present time is most opportune, and if the man of science will only realise that laboratory results are not by any means conclusive, he will find the man of commerce will help him in researches of a practical nature; the net result will be more commerce and a higher and better scientific knowledge.

(2) The man of science has not had facilities in his laboratory for low-temperature work. Many researches stop short at the melting point of ice or a little below.

Every seat of scientific learning should have a refrigerating apparatus as part of its equipment. No research of any kind where temperature is a function can be considered complete that does not go down to the lowest limit reasonably attainable, yet how many institutions are there where such investigations are possible? The lack of such facilities, in the light of recent advances all over the world, will constitute a serious disadvantage to our men of science, and the question must be taken up by every scientific body in the kingdom.

The author suggests:—

(1) That institutes of research and schools of refrigeration should be instituted in London and Liverpool. (This suggestion has been approved by the Cold Storage and Ice Association.) These institutes would be attached to learned institutions, and would act as centres for research work and the higher instruction of graduates (or others duly qualified) in medicine, science, engineering, and veterinary science from home and Colonial universities. They would also keep definitely in touch with Government departments and associations interested in low-temperature work.

(2) That every seat of scientific learning should provide facilities for low-temperature study and research.

(3) That every engineering school of university rank should provide facilities for refrigerating engineering study and mechanical research.

(4) That the principal technical colleges and schools under the Board of Education should be provided with facilities for instruction in mechanical refrigeration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The first election to a biological scholarship under the bequest of the late Mr. Christopher Welch, of Wadham College, will take place in July next. The scholarship is of the annual value of 100*l.*, and is tenable for four years. Candidates must be undergraduate members of the University; they may offer either botany, animal physiology, or zoology, and

must give notice of the subject selected to the registrar of the University not later than March 1. They may submit to the examiners any original work previously done by them.

The Committee for Anthropology reports that nine fresh students entered their names on the register during 1917, as against eight in 1916. Miss M. Czaplicka has delivered a course of lectures on ethnology, with special reference to her Siberian researches. She has been assisted in the preparation of the scientific results of her expedition by a grant from the committee. Lady Tylor has offered the valuable scientific library of the late Prof. Sir E. B. Tylor to the Radcliffe Library on condition that such books as are not needed to supplement that collection shall be placed at the disposal of the Committee for Anthropology.

THE Department of Agriculture and Technical Instruction for Ireland has issued the time-table of technical-school examinations which it will hold on various dates during May next. The Department's scheme of technical-school examinations is designed to follow courses of instruction extending over four years in the following branches of technical knowledge:—Commerce, building trades, applied chemistry, electrical engineering, mechanical engineering, domestic economy, and art. There are, in general, two examinations in each course in each of the four years, and the examinations in each course must be taken in a prescribed order.

IT was agreed in the House of Commons on February 1, in a discussion of the Lords' amendments to the Representation of the People Bill, that the University of Wales should be separately represented in Parliament. When the Bill was in the House of Lords, Lord Peel, the spokesman for the Government, accepted an amendment to give to the University of Wales, instead of being one of a group of universities returning two members, a member to itself, and he appealed to the Home Secretary to assent to this being done. The request made on behalf of the University has now been granted. The position of university representation is, therefore, that Oxford and Cambridge retain two members each; London has one; Wales one; a single constituency is formed by the group composed of Durham, Manchester, Liverpool, Leeds, Sheffield, Birmingham, and Bristol, and the Scottish universities form one constituency returning three members.

THE report on the work of the Department of Technology of the City and Guilds of London Institute for the session 1916–17 has now been published by Mr. John Murray at the price of 6*d*. net. The total number of candidates examined in technology in the United Kingdom in 1917 was exactly 1000 fewer than in 1916, viz. 7508 as against 8508. The candidates entering for examinations in England and Wales in 1917 numbered 85 per cent. of those in the preceding year, and in Scotland 91·5 per cent. In Ireland, on the contrary, there was an increase of 25 per cent. on the figures for 1916. In spite of this general decrease in Great Britain there was an appreciable increase in the number of students attending classes in certain chemical subjects, such as alkali manufacture, coal-tar distillation, painters' oils and colours, oils and fats, cotton dyeing, leather dyeing, and dressing of skins. After a consideration of the proposed new regulations issued by the Board of Education for continuation, technical, and art courses in England and Wales, the Technology Committee of the institute contemplates no change in its system of examinations, which is to be continued on the same lines as heretofore. The programme of the current session's work includes no new subjects of examination, but a special *vivâ voce* and practical examination is announced in connection with the highest tests in cotton weaving.

IN *Mind* (New Series, No. 105) Mr. P. J. Hughesdon discusses the relation between art and science. He argues that, at a time when education reform is being called for but still debated on the basis of an inadequate, and in part false, antithesis of the classics *versus* science, a satisfactory scheme of education must, whatever adaptations to tradition, etc., may be advisable, start with a correct view of the relation between the various aspects of truth or spheres of knowledge. He discusses the causes which have obscured the true relation of art and science, causes which, by exaggerating the particular domain of each, have deepened the gulf between them, chief among which is the erroneous view that art is concerned primarily with feeling and science with thought. The writer maintains that art and science provide complementary and correspondent conceptions of reality; in both the freely conceiving mind is active, but the organon of art is intuition or imagination, through which the nexus in the context of reality is divined implicitly and under the aspect of fitness or harmony, while that of science is reasoning, through which the nexus is recognised explicitly and abstractly under the aspect of ground, or reason, the essence of art lying in individualised representation, that of science in generalised explanation. The article is interesting, and furnishes some valuable points of view to those interested in the more fundamental problems underlying art and science.

THE *Journal of the Board of Agriculture* for December last contains an account by Mr. A. W. Ashby of some interesting features of agricultural educational work in connection with the State College of Agriculture, University of Wisconsin. It is an essential condition of graduation in agriculture at the University that the student must have previously secured at least two years' experience in farming. In order to ensure facilities for such experience to be obtained under good conditions a system of examining farms and awarding certificates of good management was established some years ago, and has proved very successful. In addition, university honours have been awarded to farmers who have rendered distinctive service to their profession or to their localities. During the past six years twenty-one farmers have been honoured in this way, of whom only three could claim academic training. A further feature which is described is the annual farm management contest, in which, despite the small financial inducement offered, competition is always keen. The awards are based upon a definite scale of "points," and it is specially interesting to note that no less than 20 per cent. of the total is allotted to "home life," a decidedly novel item in such score-cards. The importance of this factor is apparent to the student of rural conditions, even in this country, but in a country of widely scattered homesteads, where each must of necessity function as a largely self-contained social centre, the amenities of existence must bulk largely in ensuring the permanence of labour supplies, upon which a steadily prosperous agriculture must depend.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 24.—Sir J. J. Thomson, president, in the chair.—Prof. A. N. **Whitehead**: Graphical solution for high-angle fire.—Spencer **Pickering**: Flocculation. The subsidence of suspended matter on the addition of a flocculant to a mixture of kaolin and water is accompanied by an increase of 100 to 260 per cent. in the specific volume of the sediment deposited.

This increase, as well as the disappearance of Brownian motion, proves that flocculation is due to an increase in the size of the particles. With acids as flocculants, definite combination between them and the kaolin occurs, the acid being almost completely removed from the solution up to the point when flocculation is complete, beyond which no more is removed. The acids being in a highly hydrated condition accounts for the increase in volume of the kaolin particles on uniting with them. With alkalis the phenomena are the same, but combination is complete only in the presence of excess of alkali; hence the concentration at which flocculation occurs is much higher. In very weak alkaline solutions where there is but little actual combination, the subsidence of the particles is retarded by the attraction of the alkali present.—Dr. J. **Aitken**: Revolving fluid in the atmosphere. The paper deals with the objections to the cyclonic theory of circulation recently advanced by Sir Napier Shaw. These objections are founded on the fact that the charts of isobars and winds of the weather maps nowhere show a circulation such as would be given by a combination of the motions of rotation and translation. It is pointed out that these objections are based on suppositions which do not find support in Nature. If the cyclone were a closed system, the winds would be such as Sir Napier says they ought to be, but as the cyclone is an open one and draws in air at its lower end, and as this incoming air is only on its way to become part of the system, it cannot be treated as having the revolution and translation of the cyclone. If the combination of these two motions is to be found anywhere, it will probably be in the higher winds, and even there they will be affected by the general circulation in the system. —Hon. R. J. **Strutt**: Ultra-violet transparency of the lower atmosphere and its relative poverty in ozone. (1) The lower atmosphere is found to be comparatively transparent to ultra-violet light. The λ 2536 can be detected on the spectrum of a mercury lamp four miles distant. (2) The solar spectrum, even when observed from high altitudes when the equivalent thickness of air overhead (reduced to N.T.P.) is less than four miles, is limited by atmospheric absorption to λ 2922. Air near the ground-level is therefore much more transparent to ultra-violet light than the upper air. (3) Since the limitation of the solar spectrum is almost certainly due to ozone, it follows that there must be much more ozone in the upper air than in the lower. (4) Scattering by small particles acts in the same way as ozone to absorb ultra-violet radiation from a distant source, and this action makes quantitative estimation difficult. Even if the observed enfeeblement of λ 2536 were entirely due to ozone, 0·27 mm. of pure ozone in four miles of air would suffice to produce it. Taking scattering into account, the quantity is probably much less, and there is no evidence from this investigation that any ozone is present in the lower air.—Prof. A. **Fowler**: The presence in the solar spectrum of the water-vapour band λ 3064. The band at λ 3064, which is usually attributed to water-vapour, is quite strongly represented in the solar spectrum, and accounts for at least 150 lines which were previously unidentified.—Prof. A. **Fowler** and C. C. L. **Gregory**: The ultra-violet band of ammonia and its occurrence in the solar spectrum. The ammonia band having its greatest intensity at λ 3360 has been photographed with high resolving power, and the positions of 260 component lines have been determined. In the principal maximum, and in a secondary maximum at λ 3371, the band lines are very closely crowded and form series of the usual type. On the less refrangible side the principal lines form three series which coalesce and fade out at λ 3450, and there is a similar set of three series on the more refrangible side which coalesce and disappear at λ 3287. These two groups, however, are not symmetrical, and they differ considerably from the more usual type of series. It is shown that the ammonia band lines are consistently represented in the solar spectrum and account for about 140 faint lines which were previously unidentified. The remaining band lines are either too weak to appear in the sun or are obscured by lines of metallic origin. The brightest part of the ammonia band accounts for the greater part of Group P of the solar spectrum.

Geological Society, January 23.—Dr. Alfred Harker, president, in the chair.—Prof. W. J. **Sollas**: A flaked flint from the Red Crag. The remarkable specimen forming the subject of the paper was obtained by Mr. Reid Moir from the base of the Red Crag exposed in the brick-pit worked by Messrs. Bolton and Co. near Ipswich. It is a fragment of a nodule of chalk-flint, irregularly rhombic in outline, with a nearly flat base and a rounded upper surface which retains the whitish weathered crust of the original nodule. The base was formed by a natural fracture which exposes the fresh flint bordered by its weathered crust. Both upper and under surfaces of the specimen are scored with scratches which are mainly straight, but in some cases curvilinear. Two adjacent sides have been flaked by a force acting from below upwards, in a manner that recalls Aurignacian or Neolithic workmanship. The two edges in which the flaked faces meet the base are marked by irregular minute and secondary chipping, such as might be produced by use. On the hypothesis that the flint has been flaked by design, these edges should correspond with the "surface d'utilisation" of M. Rutôt, and one would expect to find on the opposite edges of the flint the "surface d'accommodation," as, in fact, is the case. The origin of the flaking is discussed, and the author, while admitting that the fashioning of the flint is not inconsistent with intelligent design, concludes that the evidence is not sufficient to establish this beyond dispute.

MANCHESTER.

Literary and Philosophical Society, January 22.—Prof. S. J. Hickson, vice-president, in the chair.—J. W. **Jackson**: The association of facetted pebbles with Glacial deposits. The object of the paper was to place on record several recent discoveries of facetted and wind-etched pebbles in localities near Manchester and in the Wirral peninsula, and to discuss the association of such pebbles with Glacial deposits. The pebbles are of Glacial origin, and all show the characteristic features of wind-erosion. The most noteworthy feature, however, is the large number of split and fractured pebbles, all of which exhibit the action of sand-blast on the fractured surfaces, in addition to other parts of the pebble. All stages towards the formation of typical "Dreikanter" are exhibited. The splitting appears to have been independent of rock composition, as both igneous and sedimentary rocks are represented in the series; in the latter they are mainly split along joint-planes. The mode of occurrence shows that the pebbles were acted on by sand-blast after the deposition of the Glacial beds on which they lay, and in this respect they agree with similar pebbles found in North Germany and in North America. It is suggested that the splitting is due to frost action, and that it is somewhat earlier than the wind-erosion.—The late E. **Halkyard** (paper edited and revised by E. Heron-Allen and A. Earland): The fossil Foraminifera of the Blue Marl, Côte des Basques, Biarritz. The Blue Marl of Biarritz forms a cliff stretching for nearly three-quarters of a mile N.N.E.

to S.S.W., and attains a height of about 135 ft. The height is maintained for about two-thirds of its length and dies away at the valley of Chabi. The paper contains an account of the genera and species of Foraminifera found by Mr. Halkyard in this blue marl, and is illustrated by eight plates of figures.

DUBLIN.

Royal Dublin Society, January 22.—Dr. G. H. Pethybridge in the chair.—Dr. A. G. G. **Leonard** and P. **Whelan**: The quantitative spectra of lithium, rubidium, cæsium, and gold. The utility of spectrum analysis has been greatly enhanced by a knowledge of the persistency of the spectrum lines in the spark spectra of dilute solutions of the metals. The present paper is a continuation of the quantitative study of these spectra, and includes the results obtained for the metals lithium, rubidium, cæsium, and gold.—Capt. E. G. **Fenton**: Studies in the physiography and glacial geology of southern Patagonia. This paper, which is the result of several years of personal observation on the pampas from the coast region at the mouth of the Gallegos River to the Andes, describes the way in which the generally level country has been cut into by the streams, and the formation of successive terraces by repeated flooding and erosion. The distribution of large ice-borne boulders enables the limits of a large ice-sheet of Glacial times to be determined, and the author shows that there were at least two epochs of ice-extension from the Andes. An epoch of dry south-westerly winds gave rise to a remarkable series of sand-cut grooves in the lava-blocks and lava-surfaces of the plateaus. The bajos, which are spoon-shaped excavations in the pampas, with a steep cliff at their heads, are attributed to waterfall action during the melting of the margin of the ice-sheet. The succession of events is pointed out, and the corresponding climatic changes are discussed.

PARIS.

Academy of Sciences, January 14.—M. Paul Painlevé in the chair.—E. **Ariès**: The co-volumes considered as functions of the temperature in the Clausius equation of state.—G. **Julia**: The repetition of rational fractions.—M. **d'Ocagne**: Skew surfaces circumscribed to a given surface along a given curve.—R. **Soreau**: The origin and the meaning of the word "abaque."—MM. **Lubrano** and **Maitre**: The determination of the latitude of the Observatory of Marseilles by observations made with the prism astrolabe. The mean of the determinations, reduced to the latitude of the meridian circle, is $43^{\circ} 18' 16{\cdot}35''$, a value identical within $0{\cdot}01''$ with the mean figure obtained with the meridian circle.—A. **Colson**: The cause of the anomalies presented by the dissociation of amylene bromohydrate, and its consequences. The reaction between amylene and hydrobromic acid at 184° C. was found by Lemoine not to obey the law of mass action, and this has been confirmed by the author. It is shown that this anomaly is due to the partial change of the bromopentane originally formed into an isomer.—P. **Chevenard**: An anomaly in the elasticity of carbon steel correlative to the reversible transformation of cementite. The elastic anomaly of steel, due to transformation of the cementite, is proportional to the percentage of carbon.—E. **Léger**: The action of hydrobromic acid upon cinchonine and its isomers: cinchoniline, cinchonigine, and apocinchonine. Hydrobromic acid produces phenomena of isomerisation with these alkaloids.—C. R. **Lopez-Neyra**: A new Cyrnea of the partridge. The name *Cyrnea seuratii* is proposed for the new species, and a detailed comparison is made of it and *Cyrnea eurycerca*.—C. **Vaney** and A. **Allemand-Martin**: Contribution to the study of the larva of *Hippospongia equira* from the coasts of Tunis.—F. **Diénert**, A. **Guillard**, and Mme. A. **Leguen**: The search for the Eberth bacillus and the B-paratyphoid bacillus in waters. A detailed account of the modified method now in use, the first medium being a broth containing malachite-green. The two bacilli above-named can be detected by this method in 50 c.c. of Seine water taken at Paris.—P. **Masson**: Abnormal epidermisation after bathing with hypochlorites. A warning as to possible dangers attending the prolonged use of hypochlorites for disinfecting wounds. Epidermal lesions sometimes appear which are characteristic of pre-cancerous states, and which it is necessary to excise.

SYDNEY.

Royal Society of New South Wales, December 5, 1917.—R. T. **Baker**: The occurrence of crystals in some Australian woods. Crystals of calcium oxalate were found to be of rather frequent occurrence amongst some microscopical sections of Australian timbers when being examined for anatomical data. Timbers of twenty-two natural orders were examined, and of these crystals were found in fourteen, being the first record of such in Australian timbers. The crystals were simple, being found in both the wood and ray parenchyma, a single one in each cell, with one exception.—J. H. **Maiden**: Notes on Eucalyptus (with a description of a new species). No. 5. The paper consists of supplementary notes on a number of species, many of them Western Australian. Most of the species are somewhat rare, and their life-history and morphology but little known. The proposed new species is a remarkable form which throws light on the affinities of *Eucalyptus erythronema*.—Prof. J. **Read** and Miss M. M. **Williams**: A novel application of bromine water in synthetic organic chemistry. The method bears directly upon several processes of technical importance, including the manufacture of novocaine (a well-known synthetic substitute for the natural drug cocaine) and other substances of physiological interest; it may also be applied in preparing phenyl acetaldehyde, a hyacinth perfume; and it is of interest in connection with the chemistry of the Australian natural essential oils.

Linnean Society of New South Wales, September 26, 1917.—Dr. H. G. Chapman, president, in the chair.—R. J. **Tillyard**: Some dragonflies from Australia and Tasmania.—A. A. **Hamilton**: Notes on the genus Lepidium.—W. F. **Blakeley**: A new species of Acacia.—R. **Etheridge** and J. **Mitchell**: The Silurian trilobites of New South Wales, with references to those of other parts of Australia. Part vi.: The Calymeneidæ, Cheiruridæ, Harpeidæ, Bronteidæ, with an appendix.

October 31, 1917.—Dr. H. G. Chapman in the chair.—F. H. **Taylor**: Australian Tabanidæ, part iii.—R. J. **Tillyard**: Odonata, Planipennia, and Trichoptera from Lord Howe and Norfolk Islands.—E. **Cheel**: Notes on the common nightshade (*Solanum nigrum*, Linn.) and some closely related forms or species which have been confused with it.—A. M. **Lea**: Descriptions of new species of Australian Coleoptera, part xiii.

November 28, 1917.—Dr. H. G. Chapman in the chair.—R. J. **Tillyard**: The morphology of the caudal gills of the larvæ of Zygopterid dragonflies. Parts iii.-iv. (Ontogeny and Phylogeny).—G. I. **Playfair**: Rhizopods of Sydney and Lismore.—R. J. **Tillyard**: Mesozoic insects of Queensland. No. 2: The fossil dragonfly *Aeschnidopsis* (*Aeschna*) *flindersiensis*, Woodward, from the Rolling Downs (Cretaceous) series.—R. J. **Tillyard**: Permian and Triassic insects from New South Wales in the collection of Mr. J. Mitchell.—Miss V. A. **Irwin-Smith**: The Chætosomatidæ, with descrip-

tions of a new genus and four new species from the coast of New South Wales.—H. J. **Carter**: Some new Heteromera and a new Stigmodera (Coleoptera) from tropical Australia.—Prof. W. N. **Benson**: The geology and petrology of the Great Serpentine Belt of New South Wales. Appendix to part vi.—Dr. H. S. H. **Wardlaw**: The variability of cows' milk. Samples of afternoon milk from 109 healthy cows kept under similar conditions, but of various ages, breeds, and stages of lactation, were examined. Certain physical properties, the composition, and quantities secreted in eight hours were determined. The variabilities of the results fall into four distinct groups. The percentages of results lying within five of the mean, and the percentage-deviation from the mean within which practically all the results lay, were:—(1) Freezing point and density, 100, 5; (2) electrical conductivity and concentration of soluble matter (chiefly lactose), 50, 25; (3) concentration of matter not in solution (chiefly fat and protein), 20, 50; (4) quantities secreted in eight hours, 10, 100. Only three samples contained less than 3·2 per cent. of fat, while more than 40 per cent. of the samples contained less than 8·5 per cent. of solids not fat.—Miss E. C. **Pinkerton**: The composition of expired alveolar air. Estimations of the percentage of oxygen and carbon dioxide in the successive portions of air rapidly expelled from the lungs show that the concentration of carbon dioxide diminishes by not more than 0·22 per cent. in the final 600 c.c. respired, and that the concentration of oxygen increases by not more than 0·36 per cent. in the same portion of the breath. The change in concentration is independent of the depth of respiration, but depends on the speed with which the air is expired; the more slowly the air is breathed out the greater the change in concentration of the gases of the final portion. The results obtained lead to the inference that the alveolar air in the pulmonary atria, at the end of an expiration, contains a lower concentration of oxygen and a higher concentration of carbon dioxide than the air last expelled from the mouth in the rapid expiration.

BOOKS RECEIVED.

The Principles and Practice of Pruning. By M. G. Kains. Pp. xxv+420. (New York: Orange Judd Co.) 2 dollars net.

Comment Economiser le Chauffage Domestique et Culinaire. By R. Legendre and A. Thevenin. Pp. 123. (Paris: Masson et Cie.) 1.25 francs.

The Rural Teacher and his Work in Community Leadership, in School Administration, and in Mastery of the School Subjects. By H. W. Foght. Pp. xii+359. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Manual of Milk Products. By Prof. W. A. Stocking. Pp. xxvii+578. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

La Statique des Fluides, la Liquéfaction des Gaz et l'Industrie du Froid. By E. H. Armagat and L. Décombe. Première et Deuxième Partie. Pp. vi+265. (Paris and Liège: Ch. Béranger.) 18 francs.

DIARY OF SOCIETIES.

THURSDAY, February 7.

Royal Society, at 4.30.—The Photo-Electric Action of X-rays: Prof. O. W. Richardson.—The Parent of Actinium: Prof. F. Soddy and J. A. Cranston.—Some Problems in the Theory of Radiation: Prof. A. Schuster.—The Absorption of the Radiation Emitted by a Palladium Anticathode in Rhodium, Palladium, and Silver: E. A. Owen.

Royal Institution, at 3.—Illusions of the Atmosphere: The Travelling Vortex and the Cyclonic Depression: Sir Napier Shaw.

Institution of Electrical Engineers, at 6.—Ninth Kelvin Lecture: Kelvin as a Teacher: Prof. M. Maclean.

Linnean Society, at 5.—Two Bibliographical Rarities of the Society's Library: (*a*) Cupani, F., "Panphyton siculum," 1713; (*b*) Du Gort, J. and P., "L'Histoire et Pourtrait des Plantes," Lyon, 1561: The General Secretary.—Plant Distribution from the Standpoint of an Idealist: H. P. Guppy.

Chemical Society, at 8.—Atomic and Molecular Numbers: H. S. Allen—Studies of the Carbonates. IV. The Hydrolysis of Sodium Bicarbonate and the Ionisation Constants of Phenolphthalein: C. A. Seyler and E. H. Tripp.—Some Inorganic Stannichlorides: J. G. F. Druce.—A Re-investigation of the Cellulose-dextrose Relationship: Miss M. Cunningham.—Esparto-cellulose and the Problem of Constitution: C. F. Cross and E. J. Bevan.

FRIDAY, February 8.

Royal Institution, at 5.30.—Science and Ethics: Principal E. H. Griffiths.

Royal Astronomical Society, at 5.—Anniversary Meeting.

SATURDAY, February 9.

Royal Institution, at 3.—The Ethics of the War: P. H. Loyson.

MONDAY, February 11.

Royal Geographical Society, at 8.30.—The London Society's Map with its Proposals for the Improvement of London: Sir Aston Webb.

Society of Engineers, at 5.30.—Presidential Address: W. B. Esson.

TUESDAY, February 12.

Royal Institution, at 3.—The Problems of British Anthropology: Prof. A. Keith.

WEDNESDAY, February 13.

British Association Geophysical Discussions (Royal Astronomical Society), at 5.—The Influence of Barometric Pressure on Mean Sea-level: Sir C. F. Close.—Precise Levelling: Major Henrici.

Royal Society of Arts, at 4.30.—The Relations between Capital and Labour—Reasonable Hours, Co-partnership, and Efficiency: Lord Leverhulme.

THURSDAY, February 14.

Royal Society, at 4.30.—*Probable Papers:* The Artificial Production of Echinoderm Larvæ with Two Water-vascular Systems, and also of Larvæ Devoid of a Water-vascular System: Prof. E. W. MacBride.—The Quantitative Differences in the Water-conductivity of the Wood in Trees and Shrubs: Prof. J. B. Farmer.—The Efficiency of Muscular Work: Capt. M. Greenwood.

Royal Society of Arts, at 4.30.—The Hide Trade and Tanning Industry of India: Sir Henry Ledgard.

FRIDAY, February 15.

Royal Institution, at 5.30.—The Mechanism of the Heart: Prof. E. H. Starling.

Institution of Mechanical Engineers, at 6.—Annual General Meeting.—Traction on Bad Roads or Land: L. A. Legros.—Utility of Motor Tractors for Tillage Purposes: A. Amos.

SATURDAY, February 16.

Royal Institution, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

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THURSDAY, FEBRUARY 14, 1918.

LIFE AND WORK OF JAMES GEIKIE.

James Geikie: The Man and the Geologist. By Dr. M. I. Newbigin and Dr. J. S. Flett. Pp. xi+227. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1917.) Price 7s. 6d. net.

THE life of James Geikie deserved to be written, for he was not only a good geologist with marked literary gifts, but also had an innate love of travel, Nature, and the humorous, with the art of making friends. The task has been well done, the biographical part by Dr. Marion Newbigin, the strictly geological by Dr. J. S. Flett. The book avoids the error, so common in biographies, of needless prolixity; it contains well-selected specimens of Geikie's letters and writings, grave and gay, with three good likenesses and an amusing sketch, and abstains from commonplace padding.

Born at Edinburgh in 1839, James Geikie (Murdoch, his second Christian name, was early discarded), after its High School and a short period of uncongenial employment, obtained, in 1861, an appointment to the Geological Survey. On that he worked for twenty years, rising to be District Surveyor, then gave it up reluctantly to become Murchisonian Professor in the University of Edinburgh. One of his earliest duties in the former capacity was to map the drifts of Fifeshire and the Lothians, which attracted him to the problem of their origin and moulded his future studies. Then he went on to the solid geology of Ayrshire, the Lanark coalfield, the Cheviots, and other districts of southern Scotland. As professor he discharged the duties of his chair zealously until the early summer of 1914, and on March 1 of the following year died suddenly from heart failure. As a worker, whether in the field, the class-room, or the study, he was indefatigable; in fact, he evidently overtasked even his vigorous constitution, often suffering in his later years from more than one form of nervous exhaustion, and probably somewhat shortened his span of life. Notwithstanding his numerous ties, professional and social—for he was a devoted husband, father, and friend—he was able to see more than a little of other lands, visiting Iceland, the Faröes, and Norway, France, Germany, Switzerland, and Italy, with Egypt, the Canaries, Canada, and the United States, always keenly observant and gathering notes for use in the lecture-room and his numerous contributions to scientific literature.

The most outstanding of his works are "The Great Ice Age" and "Prehistoric Europe." Of them and of the author's position in the Glacial controversy Dr. Flett writes clearly, concisely, and apparently as if he thought his client to have gained his cause. Be this as it may—and the present writer unfortunately differs in some important respects from the late professor's interpretation of Nature's hieroglyphs of the Ice age, scarcely less than from his inferences about metamorphism in Ayrshire—all students will gladly acknowledge the value of the above-named books. The third edition of "The Great Ice Age" (published in 1894) is a veritable mine of information, collected from many lands and diverse sources, about its deposits and their significance; and the other volume—"Prehistoric Europe"—discusses in addition the advent of man, which, according to its author, was anterior to the Glacial Epoch.

But even antagonists who think that he was a little too prone to put his trust in Continental prophets of the Ice age (when they were favourable to his views), and to ignore rather than to refute the criticisms of opponents, will assign a high place to these volumes as works of reference. The same may be said of his geological articles—and they would themselves make a volume—in "Chambers's Encyclopædia," where he successfully puts off the advocate to become the judge. In all that he published his style was attractive; he evidently wrote with facility, sought to make himself intelligible, and never shirked his work. In brief, he was a many-sided, very able, and most genial man, who had the power of winning the regard of his students, and whose loss was regretted by everyone who had been his workfellow, his friend, or even his antagonist.

T. G. BONNEY.

THE COMPLETE DAIRY FARMER.

Dairy Cattle Feeding and Management. By Dr. C. W. Larson and Prof. F. S. Putney. Pp. xx+471. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 11s. 6d. net.

THE ancient art of agriculture has always been invested with a halo of romance, through which only in times of the severest national stress has its essentially prosaic character as the great industry of food production been clearly discernible to the popular eye. In the lay imagination the idea commonly persists that the art still retains essentially its primitive form, amounting to little more than a crudely systematic collection of the gifts which from year to year a benevolent, though not always generous, Providence is pleased to bestow upon mankind.

It is lamentable, but inevitable, that in all aspects of human activity the advance of knowledge should tend to overlay the rosy tints of romance with the more sombre hues of reality. The philosopher-ploughman of yesterday gives way to the motor engineer of to-morrow; the milking machine dispels the last vestige of romance from the art of the dairymaid.

In the days before the Industrial Revolution the production of milk was largely incidental to the production of crops and meat, and the needs of the community could be satisfied without recourse to even such simple intensive methods of milk production as could then have been employed. With the steady divorce of the food consumer from food production, and the increasing dependence of civi-

lised peoples upon cow's milk for the feeding of infants, the need for the development of milk supplies and for the organisation of distribution has steadily grown until at the present time the production of milk has been developed by the leaders of the industry into the most highly organised and efficient branch of agriculture in the more densely populated regions of the civilised world.

Before the development of modern science the business of milk production was necessarily run on simple lines. Alternative feeding-stuffs were few in number, and the significance of chemical composition was unknown. With the development of chemistry and physiology, and the consequent elucidation of the fundamental principles of nutrition, a more elaborate adjustment of rations to milk output became possible, and was further facilitated by the increased range of feeding materials which the concurrent expansion of commerce and industry placed at the disposal of the farmer. The discovery of micro-organisms and of their relation to public health has exercised, and must continue to exercise more and more, a potent influence upon the methods of milk production and distribution. A knowledge of the principles underlying improvement of livestock by breeding has also become an essential item in the intellectual equipment of the modern dairy-farmer, and acquires additional importance with the development of the infant science of genetics. The further complexities introduced by the modern developments of transport and marketing facilities are obvious.

It is thus patent that the technical education of the dairy-farming expert of to-day cannot be compressed into any narrow curriculum, and demands for its efficient assimilation a level of intellect and capacity which is scarcely associated as yet in the public mind with the farming industry. The provision of the necessary educational guidance is a formidable task that has nowhere been faced with more courage and success than in America. From their inception the American agricultural colleges and experiment stations in dairying areas have placed great emphasis upon the importance of scientific method in dairy-farming, and the literature of the subject bears witness to the persistent effort which has steadily brought American work into the very foremost position in this branch of applied science.

As in so many other branches of technology and science, British readers in the past have been accustomed to draw largely upon German literature, but in this particular field the German has been surpassed, and no country now possesses a dairying literature equal in volume and general level of quality to that which America has produced. The work of Dr. Larson and Prof. Putney is an excellent example of the best type of modern American text-book, and is primarily designed to secure the closest co-ordination between class-work and private study. The material is arranged in twenty-nine lectures, which cover the whole field of feeding, breeding, management, hygiene, housing, cost accounting, and distribution. A commendable feature is the outline of a course of practical work which is given in the appendix. It is obvious that an exhaustive treatment of the subject is impossible within the compass of one volume of this size, and some sections bear evidence of compression beyond what the student may reasonably expect to find. On the whole, however, the compression has been judiciously effected, without omission of essential information or of adequate illustrative matter from experimental records. The work may be warmly commended to the dairy student and teacher as being perhaps the most comprehensive class-book on the subject. C. C.

PHILOSOPHICAL IDEALISM AND NATURAL SCIENCE.

The Idea of God in the Light of Recent Philosophy. The Gifford Lectures delivered in the University of Aberdeen in the Years 1912 and 1913. By Prof. A. Seth Pringle-Pattison. Pp. xvi+423. (Oxford: At the Clarendon Press, 1917.) Price 12*s.* 6*d.* net.

IN his recently published Gifford Lectures, Prof. Pringle-Pattison, starting from Hume's "Dialogues concerning Natural Religion," passes in review the reasoning of successive philosophical writers up to the present time on the nature of ultimate reality. His personal point of view is that of the idealism so strongly represented in recent British philosophy, including his own former works; but in the course of very acute and yet thoroughly sympathetic criticisms of other writers, and particularly his fellow-idealists, he has now carried philosophical idealism a considerable step forward, and brought it into more living touch with natural science and other developments of human thought and action. A clear and very graceful literary style adds largely to the value of what is unmistakably a great philosophical book.

To many men of science it will perhaps come as something of a shock to find that the world of apparent "objective" physical reality is treated by philosophers as only the one-sided or subjective appearance of a deeper reality. Prof. Pringle-Pattison traces the steps by which philosophical thought has developed in the direction of showing that the real world is a world of what he constantly refers to as "intrinsic values." "Idealism," as he puts it, "takes its stand on the essential truth of our judgments of value, and the impossibility of explaining the higher from the lower. Beauty and goodness are not born of the clash of atoms; they are effluences of something more perfect and more divine." A distinctive key-note of the book is his treatment of imperfection and suffering as organic to the development and very existence of these intrinsic values. The hedonistic test of perfection is examined and rejected.

Perhaps the designation "idealism" is somewhat misleading. What it mainly indicates is a direct historical descent from Berkeley, Hume, and the great German idealists of a century ago. Philosophy is only the endeavour to describe reality; and the result of this endeavour, as set

forth in the book before us, is that the conceptions of the sciences are in themselves no more than inadequate ideal constructions of what can only be described finally as spiritual reality.

In a short notice it is impossible to give any detailed account of the whole book, but some reference may be made to the fourth chapter, entitled "The Liberating Influence of Biology." The author is in full agreement with those biologists who now claim that biology must be regarded as a science with a distinctive working hypothesis which separates it from the physical sciences. The basis of this claim is simply that it is not possible to describe and interpret the distinctive facts of biology in terms of the working hypothesis of physics and chemistry: the conception of life itself must be employed as a fundamental working hypothesis. In referring to this claim he is careful to dissociate himself from what is ordinarily understood as vitalism, and to show that the claim goes much farther than that of the vitalists, who occupy what seems to him an untenable position. While he agrees, for instance, with Driesch's criticisms of the mechanistic account of life, he points to radical weakness in Driesch's own vitalistic position. The "liberating" influence of biology results from the fact that the new biology treats as mere working hypotheses of limited application what had come to be regarded as absolute truths established by physical and chemical investigation. He points out that a similar liberating influence has resulted from recent discoveries as to the nature of atoms. There is thus no reason now for concluding that in ultimate analysis the phenomena of Nature, including human activity, must be reducible to an interplay of material particles, in accordance with the metaphysical theory which he designates as "naturalism." The way is left open to interpretations on a higher plane, and each of the sciences is left free to use its own special working hypotheses.

Perhaps most scientific readers will be inclined to think that the author under-estimates the strength of the position of what he calls the "old guard" of mechanistic biologists; but, however this may be, his treatment of the whole subject, and references to Darwin, Huxley, Bergson, Driesch, and other writers, will be found to be of much interest.

The book may be recommended confidently to all those who wish to understand modern philosophical idealism and the grounds for its uncompromising rejection of "naturalism."

J. S. H.

OUR BOOKSHELF.

Highways and Byways in Wiltshire. By E. Hutton. With illustrations by Nellie Erichsen. Pp. xvii+463. (London: Macmillan and Co., Ltd., 1917.) Price 6s. net.

THIS book, with its charming illustrations from pen-drawings, is more nearly a guide to the ecclesiastical and monastic architecture of the Middle Ages in Wiltshire than any other yet published. It is not, it is true, in the form of a guide-book, but is arranged more or less as a description of a series of walks, taken by the author from different centres, beginning with Salisbury and South Wiltshire, which is treated of far more fully than the northern portion of the county.

The author has, indeed, an eye for natural scenery and dwells thereon at length on occasions; but his real interest lies in medieval architecture and in Church life previous to the Reformation, which for him is the end of all things good in Wiltshire or in England. As for Puritans, Protestants, Anglicans, they are, with scanty exceptions, anathema to him. George Herbert, Richard Hooker, and the "White King" are, it is true, amongst the exceptions, but for everybody even remotely connected with the destruction of the monasteries, for Seymours, and Thynnes, and Hungerfords, and especially Bayntons, he can find no words to fit their baseness. The only greater criminals are the modern restorers of churches. Of the restored statues in the West Front of Salisbury Cathedral he remarks: "Is it not monstrous that ignorance and imbecility should be allowed to disport themselves on such a work as this?" Yet, for all his violent preferences, he writes well and very readably, and for those whose interests lie in the same direction as his own there is a vast deal of architectural information, very largely taken, as he acknowledges, from the pages of the *Wiltshire Archaeological Magazine.* But it is a pity that the proofs were not more carefully read by the author. There are many misspellings and misprints, some of which make nonsense of the passages in which they occur. The index is good.

The Vegetable Garden. By Ed. J. S. Lay. (The Pupils' Class-book Series.) Pp. 144. (London: Macmillan and Co., Ltd., 1917.) Price 1s. 6d.

ELEMENTARY education is indebted to Mr. Lay for a number of school books on various subjects intended to train children to do more and think more for themselves. Were school gardening made a subject of scientific study as well as of manual instruction, it would teach children to think as well as to work. Unfortunately, this is not always the case, and, even in the counties where most is done to encourage observation and experiment, many gardening teachers find it difficult to get away from rule of thumb. If only to help such, Mr. Lay's book is to be welcomed. Intended for class reading to accompany outdoor work, it not only describes the operations, crops, insect pests, etc., of the garden, but also puts, in an interesting way, the problems that have to be faced, and leads the children to make simple experiments through the results of which many of the problems can be tackled intelligently. As a class reader it is the most useful gardening book that has yet appeared in this country, and its use should greatly enhance the value of school gardening as a means of real education. It comes at an opportune time, for in connection with the food production campaign school gardens are being multiplied, so that a host of new teachers will be grateful for its guidance.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Flights of Rooks and Starlings.

I MAY be writing of what is so commonly known to naturalists as to be unworthy of record; the facts, however, are new to me. On a fine, still day last September I observed a large flight of rooks attended, as Gilbert White notes, by starlings. As they passed across the sky both rooks and starlings mounted higher and higher until they were lost to sight in the distance. Whatever may have been the occasion of the concourse, it was a subject of much interest to rooks in general, for solitary birds hurried by, cawing loudly, to join the main body. These belated individuals mounted in fairly regular spirals.

About a fortnight later I had the good fortune to be able to follow with powerful glasses a similar flight, but of rooks unaccompanied by starlings. As before, the mean movement in the still air was a steady oblique ascent, and the general impression that of a crowd of birds the individual movements of which were confused and irregular. This impression of confused flight was, however, probably wrong, for the few individual birds I was able to follow were undoubtedly rising in fairly regular spirals.

The surprising and, to me, novel character of the flight did not appear until the birds had risen to a height beyond the limits of unaided vision. The movements of individual birds then changed from the even sweep of the spiral to what can only be called trick flying. The wildest antics were indulged in, the commonest being a dive with closed wings, the bird sometimes rolling over and over. I could not fit the character of the movement to the hypothesis that the birds were darting after insects on the wing.

The two facts new to me were the height attained and the fact that a bird of such sedate manners as the rook should on occasion condescend to do "stunts."

W. B. HARDY.

The Athenæum Club, Pall Mall,
February 4.

National Union of Scientific Workers.

THERE is appearing in your advertising columns an announcement relating to this Union; will you allow me space to explain its objects very briefly, but rather more fully than is possible in an advertisement?

There is a general agreement that it is imperative for the best interests of science that those who pursue it should possess greater political and industrial influence. The founders of our Union believe that they can attain that influence only by adopting the form of organisation which has proved effective in experience. That organisation involves the formation of a Union including, so far as possible, every professional scientific worker, and governed in a completely "democratic" fashion. It is such a Union that we are trying to form.

In the pamphlet for which everyone is urged to write further details of our aims and methods of attaining them are suggested. But we feel that no self-appointed body can possibly legislate permanently for a Union designed to embrace the whole world of science. Our immediate endeavours, therefore, are to set up a preliminary organisation which will lead to the summoning of a thoroughly representative general meeting having the authority necessary to set the Union on a permanent basis. The pamphlet is mainly devoted to an account of this organisation. Until it has done its work the constitution and policy of the Union will remain unsettled; we would urge accordingly that any divergence, except on the fundamental principle, from the views of the founders is an argument for, rather than against, taking part in the preliminary work.

One last point. We are often asked what is our attitude towards other societies, existing or proposed. Our answer is that, since none of them are both all-inclusive and democratically governed, none, according to our view, can do our work. But, of course, we recognise that there are other ways of advancing the cause of science which are being followed effectively by other bodies. We recognise further that our relations to these other bodies will need careful consideration and regulation; but to discuss exactly what the relations must be would be to exceed the space I can ask you to put at my disposal.

NORMAN R. CAMPBELL
(General Secretary N.U.S.W.).

North Lodge, Queen's Road, Teddington.

THE GREEN LEAF: ITS SCIENTIFIC AND ECONOMIC EXPLOITATION.

THROUGHOUT the unnumbered ages which have witnessed the rise and fall of successive civilisations upon this planet, the one thing that has stood between mankind and extinction by lack of food has been the activity of the chloroplast of the green leaf. Perhaps, before equal time has again rolled over the world, the synthetic production of food may have been achieved, and man in all his intellectual glory may claim equality with the lilies of the field. Until then the fixation of organic carbon by "photosynthesis" in green cells must, by us, be regarded as the basal chemical happening of our planet. Thousands of years of empiric agriculture have enabled man to exploit this aspect of vegetation with remarkable success, but the problem of carbon assimilation found its way into the laboratory only at the end of the eighteenth century by the genius of Priestley, and its broad aspects were first formulated by the wisdom of De Saussure in 1812.

We may consider in this article what progress has been made with this matter, as a problem of pure and applied science, in the century that has elapsed since then. The recent appearance of a summary review of our knowledge of the subject by I. Jφrgensen and W. Stiles[1] gives a good foundation for such consideration.

Investigators have not been idle. The bibliography contains 250 entries, but these are not a tenth of the papers published, for our authors' intention is to ignore historical development and give only a critical account of those researches which mark the present advance line of knowledge on the many separate, but converging, roads by which this well-defended secret of Nature has been attacked. The authors are as severely critical as the commissioners on a military campaign. They have carefully thought over the aspects of the subject

1 "Carbon Assimilation: A Review of Recent Work on the Pigments of the Green Leaf and the Processes connected with Them." By Ingvar Jφrgensen and Walter Stiles. *New Phytologist* Reprint, No. 10. Pp. 180. (London: Wesley and Son, 1917.) Price 4s.

as one connected whole, and are impatient of the many individual attacks which have wasted half their effort by failure to keep contact with flanking movements by workers coming from other directions, who should be regarded as allies, but are often treated as rivals. This report ought to have a valuable effect in unifying research activity. No similar presentation of the subject has appeared before in any language.

A century of laboratory attack has driven several salients forward, of which perhaps three stand out conspicuously. We may briefly consider how far each has progressed, as reported in this pamphlet, and what may be expected of the future. These advances concern (1) the pigments of the leaf (chap. ii.); (2) the products of carbon assimilation formed in the leaf (chap. v.); and (3) the influence of external factors on the rate of carbon assimilation (chap. iv.).

In chap. vii. will be found set out those speculations that have any significance as theories of the assimilation process. During the process that takes place in the illuminated green cell, whereby carbon dioxide disappears and sugar appears, it is clear that, somehow or other, reduction and "synthesis" must take place; but even now it is quite unclear to what system of reactions this result is to be attributed. Many hypotheses have been put forward, and Baeyer's "formaldehyde theory" has been almost canonised as an eternal verity, yet there is really no good evidence for it. Its perennial attraction no doubt is due to its æsthetic simplicity. It appears now that the reaction must be much more complex (unless, as is possible, we are entirely on the wrong tack), and this is our excuse for the slowness of progress. A knowledge of the reacting system at work would be equivalent to storming the citadel of the whole defence, but so far no one has advanced a satisfactory hypothesis that can be put to the proof of experiment. We have still to advance by slow hammering tactics from various directions.

The advance that has been made in elucidating the nature of the pigments of the green leaf under the guidance of Prof. Willstätter really amounts to a shock attack, so continuous and rapidly widening has been the progress.

In 1864 Sir George Stokes stated that he had proved that the green matter of leaves consisted of two green and two yellow pigments, though he never published his evidence. In the last decade this conclusion has been finally established by the monumental research of Prof. Willstätter and his colleagues. Before Prof. Willstätter there was no clue to the real chemical nature of these two green pigments, and it could be hoped that when their chemistry was known the process of reduction of carbon dioxide would be elucidated.

The curious nature of the green and yellow pigments is now made quite clear; the greens are esters of a big alcohol molecule, phytol, and a tricarboxylic acid based on a nucleus of four pyrrole rings. Magnesium is also an essential constituent, not electrolytically dissociable, but believed to be directly united with the nitrogen. The difference between the two green pigments is simply this, that "chlorophyll *b*" contains one atom more of oxygen (and two less of hydrogen) than "chlorophyll *a*." In complete contrast to this complexity is the simplicity of the yellow pigments; "carotin" is an unsaturated hydrocarbon, and "xanthophyll" an additive oxidation derivative of it. Both the yellows, when isolated from the cell, spontaneously absorb oxygen in abundance. It is easy to assume that these differences of oxygen-potential occurring within both the green and the yellow pairs are significant for the reduction of carbon dioxide; but there is no evidence on this point at present.

A second line of attack into which much work has been put is the determination of the nature and amount of the carbon-containing substances which arise in the leaf as CO_2 disappears. Is the CO_2 quantitatively reduced to its theoretical yield of carbohydrates, or do other substances arise in "multiple photosynthesis"? The measurement of the CO_2 intake by the green leaf is not difficult, but difficulties attend the correction of this apparent photosynthesis for the amount of CO_2 simultaneously produced in the body of the leaf by respiration—an amount which is large at high temperatures, but must be known and added in for exact statements of photosynthesis. At the other end of the reaction the determination of the carbohydrates produced continues to present considerable difficulties, so that no one has yet managed to measure in one experiment both the initial CO_2 used up and the final carbohydrates produced whereby we might judge of their equivalence. Much discussion has taken place on the question of what is the first sugar to appear in photosynthesis, though this is largely a strife of ideas rather than of facts.

The identification and accurate determination of individual sugars and polysaccharides in a mixture of such bodies form a special field of analytical work the difficulties of which have been much lightened by recent English researches, set out in chap. v.; but these have not been fully overcome yet. Further, these carbohydrates have all to be extracted from the leaf unaltered by the enzymes that lie in wait for them in the cell, and finally not one determination, but two differential determinations are required to establish changes due to photosynthesis; one, at the beginning of the experiment, being on some other area of leaf that can be held to furnish a strictly comparable control. Progress in this important line of work waits upon absolutely trustworthy methods of extraction and analysis of carbohydrates.

The third significant advance that has been made is that towards an understanding of the influence and mode of interaction of the many external and internal factors that can influence the rate of photosynthesis. The control or measurement of the external factors of illumination (sunshine or artificial light), temperature, and CO_2 supply, require elaborate apparatus and considerable physical experience in the fields of radiometry, photometry, scientific illumination, thermo-electric measurement of leaf temperature, etc. Of internal factors the amount of chloro-

phyll and the degree of openness of the stomata are sometimes significant.

When the magnitudes of the three external factors are known or controlled, there arises the important question of the nature of their interaction when the magnitudes of them vary independently—a problem which has been elucidated largely by English investigations. In any possible combination of these factors, the rate of photosynthesis at any moment is not an expression of their combined magnitude, but only of the magnitude of a particular one of them acting as a "limiting factor" to the rate of functional activity. Which of the factors happens to be the limiting factor in any combination of them can be determined experimentally by application of the principle that increase of the magnitude of the limiting factor, and of this factor only, can increase the rate of photosynthesis.

With high rates of photosynthesis, yet a new factor has to be brought into account, as internal causes produce a regular falling off of the power of photosynthesis from moment to moment of time. Until the internal causation of this is fully explained it may pass by the non-committal name of the "time-factor."

There is yet another important aspect of our attack on the problem of photosynthesis which is still in its infancy, and that is the "energetics" of the process, dealt with in chap. vi. of the pamphlet.

The essential human value of the chloroplast activity lies, of course, over and above the indispensable accident that its products are edible, in the high energy content of these carbohydrates. Therefore, the energetic aspect of the process is the fundamental one, and the whole problem should be investigated on this basis. This involves measurement of the energy incident on the leaf-surface, with determinations of the amount transmitted, or reflected, or used in transpiration, as compared with the fraction stored up in photosynthesis, which last finds expression in the increased heat of combustion of unit-area of leaf-surface enriched by carbon assimilation. In this field of work progress can be made only by elaborate physical apparatus and critical determination of physical constants.

Let us now turn to the economic aspect of photosynthesis regarded as a problem of industrial or applied science. In these times, when cereal food supply threatens to become a limiting factor to the endurance or free existence of nations, the question of what science can do to multiply the number or heighten the activity of the chloroplasts subserving the cause of humanity acquires a poignant interest.

It cannot be said that the physiological study of chlorophyll activity has yet enabled any improvement to be made in the applied science of agriculture. The conditions of present-day agriculture are too little intensive, and not yet such as to make it worth while to attempt to exploit the researches of plant physiologists. Cultivation of new acreage, selection of types, and increase of transport facilities are the present solutions of the limitation factor of carbohydrate food supply.

The utilisation of researches on the augmentation of photosynthesis would be of profound importance in the imaginary case of a self-contained or strictly isolated community of limited acreage, a wealthy and intelligent community with a large population on a small area of soil for sunshine or artificial illumination. Their problem would have to be solved on the basis of investigations on the factors controlling photosynthesis of the type we have already mentioned.

In such a community the relation between plant physiology and agriculture would become something like that holding now between human physiology and medicine. To-day every progress in human physiology is eagerly correlated with medicine, and lavish endowment and encouragement are extended to pure physiological science on account of its generally recognised applicability to medicine. The outlook of medicine and hygiene is, however, individual, and not commercial; there is a desire to save every life and continue the activity of every individual, however worthless it may be to the community. With agriculture and plant communities there is no such outlook, and with regard to any application of plant physiology it is required that the intensification of the synthetic activity of the plant aimed at shall pay economically.

We see, then, that it is probable that the main cereal crops will for a long time be left to the mercy of natural vagaries of light, heat, water, and carbon dioxide, but minor activities of intensive food cultivation are now utilising deliberate or unconscious control of one or more of the factors of photosynthesis. It becomes, therefore, highly important that there should be carried out a comprehensive investigation of the physiology and energetics of carbon assimilation dealing with the possibilities of intensive photosynthesis under all artificial combinations of factorial conditions. From what we have said as to the complexity of this matter it is clear that no one or even two investigators are likely to have all the special chemical, physical, and physiological experience required for rapid progress, so that this would have to be an organised combined research, and continued over a number of years with good equipment and liberal endowment.

In conclusion we may express the opinion that, in the eyes of all who know the results of modern work on chlorophyll, Germany has acquired lasting credit for her great achievement with this difficult and elusive problem. Under the inspiration of Prof. Willstätter many workers have striven for years in the National Research Institute, and thousands of pounds have been spent, on a novel type of investigation involving tons of leaf material. Their credit is not the less for this, that the results have not at once proved to be of economic importance: one more province of ignorance has been strenuously conquered and annexed to the empire of knowledge.

An equal spirit of organised research and munificent endowment in this country should enable us to raise here, on the basis of existing English pioneer work, a similar monument of research on the physiology and energetics of carbon assimilation. F. F. B.

THE ADOPTION OF THE METRIC SYSTEM.

AN account of the position of the subject of the adoption of the metric system in this country was given in NATURE of August 30 last. That the question is being very seriously considered by the controllers of our larger industries is clearly indicated by the two papers on the subject read recently before the Institution of Electrical Engineers. In the paper, "A Case for the Adoption of the Metric System (and Decimal Coinage) by Great Britain," by Mr. A. J. Stubbs, the multiplicity of standards—and, worse still, variations from these standards—is so clearly shown that one is not surprised that the writer should arrive at the conclusion that the change must come, and that delay but increases the difficulties of the change. The final conclusion, "*Do it now*," will meet with unqualified approval from those who feel that the change is urgently needed.

Very different is the paper from Mr. Llewelyn B. Atkinson on "The 'Pros and Cons' of the Metric System." Broadly speaking, it is a paper "damning with faint praise." Starting from the three possible systems, namely, (1) the British system, (2) the metric system, (3) the C.G.S. or absolute system, the writer proceeds to discuss the questions of (*a*) decimalisation, (*b*) the actual magnitudes involved, and (*c*) policy. The main point made is that there is always so much to be said for the other side that everything is questionable. The further difficulty of the enormous number of readjustments of tolls, rates, dock dues, wage lists, etc., which would have to be made, is emphasised.

If our object were simply to criticise this paper rather than most seriously to urge the adoption of the metric system in the full light of all the difficulties actually known to be involved, we should simply ask Mr. Atkinson to produce his British system—say, for the textile industries; and in reply to the difficulty raised respecting the readjustment of tolls, rates, etc., we would suggest that the sooner the whole of the agricultural and commercial worlds of this country receive the shaking up that such a change would give them the better. But the paper is too good to be thus summarily dismissed.

The question of decimalisation admittedly resolves itself into a careful weighing up of the pros and cons. That uniformity, accuracy, and speed make a strong trio in favour of the decimal system is, however, beyond question. If proof of this be required it may be readily obtained from those who have worked in both British and Continental mills and works.

The question of the actual magnitudes involved is complicated by reference to the varying weights of the bushel of wheat, of barley, of oats, etc. This is typical of the whole trend of the paper. Whatever standards of measurement be adopted, the same difficulty will be in evidence. This approximates any two systems to one another in the sense that it involves them in a common difficulty—but does it therefore leave them equally useful for world service? If there were a chance of either Japan or China adopting any such British system as could be speedily designed, there might be something in the argument. But is there?

The question of policy is debated rather from the point of view of Britain holding certain markets by the imposition and retention of her peculiar weights and measures—in other words, by the methods employed by some of our machinists, who purposely adopt their own peculiar standards in order that they may absolutely bind to themselves any firms once depending upon them for machinery. Does not this savour far too much of subterfuge? And where subterfuge comes in, in the long run efficiency goes out.

From this point of view international coinage and rates of exchange form an interesting study. If the time ever comes when the spirit of scientific finance, rather than the spirit of "opportunism," dominates industry, then will commerce have made possibly the greatest step forward on record.

In the final paragraph of his paper Mr. Atkinson asks for some indication of how the change can in practice be effected in the case of the textile industries. This change was definitely made and the metric system employed in the textile industries department of the Bradford Technical College for more than a year. The experiment revealed the simplicity of the change, and has materially influenced the views of the writer of this article on the possibilities of the metric system in the textile industries. That the cotton section of the textile industries will profit least from the proposed change is certain, since it already possesses many of the advantages conferred by a world-wide system; but surely it will join hands with its less fortunate associates in advocating a change which to those with long vision seems almost likely to be the factor deciding our fate in the commercial warfare looming ahead.

But perhaps the deficiencies of outlook in evidence in Mr. Atkinson's paper may best be attributed to an apparent lack of appreciation of the questions of mentality (or psychology) involved. Every mathematical problem solved—be it simple or complex—serves in two ways. Directly, it gives the particular answer required; and indirectly, it incorporates itself into the intuitive faculty of the thinker. Thus each problem solved will naturally tend either to strengthen or to weaken the intuitive mathematical faculty. A multiplicity of standards with many haphazard variations will inevitably tend, through confusion of precept, to suppress, and ultimately entirely to eliminate, the intuitive mathematical faculty; whereas scientific standardisation will tend to promote that type of brain culture which ultimately resolves itself into

cumulative efficiency. That our people markedly lack this intuitive mathematical faculty is too painfully in evidence. A great opportunity is opening out before us to correct this defect. Are we going to make the attempt? Risk there will, of course, always be, but in this case the risk of standing still seems to be far greater than the risk incident upon the compulsory adoption of the metric system.

A. F. B.

CONTROL OF SEX IN PIGEONS.[1]

THE late Prof. Whitman, of Chicago, was the first to show the remarkable suitability of wild pigeons for the analysis of the sex-problem. He found, for instance, that generic crosses (Columba and Turtur), when not permitted to lay many eggs, produce mostly or only males; that such pairs, when made to lay many eggs (crowded reproduction), produce males predominantly from their earlier stronger eggs, and predominantly or only females from the later eggs laid under stress of overwork; and that from eggs of pure wild species the first egg of the pair or clutch more often hatches a male, while the second egg of the pair more often produces a female. Dr. Oscar Riddle has followed up Prof. Whitman's work with very important results, bearing not only on the theory of sex, but also on possible practical control.

It seems certain that there are two kinds of eggs in the pigeon's ovary. The male-producing egg of the spring stores less material than the female-producing egg of the autumn. The male-producing egg of the clutch stores less material than does its female-producing fellow. The eggs of old females store more material and yield a higher percentage of females than do the eggs of birds not old. During the season successive clutches present higher and higher storage, and the eggs of the low-storage period give rise (in the generic cross) to males, and those of the high-storage period produce females.

Increase in storage capacity means decrease in oxidising capacity—a lowered metabolism; and the fundamental difference between the female-producing ovum and the male-producing ovum is a difference in the level of metabolism. Though there are a few discrepant results, it may be said that femaleness in the egg is associated with low metabolism, lower percentage of water, and a higher total of fat and phosphorus, or of phosphatides; and conversely for maleness. The less hydrated state of the colloids will favour increased storage, while a more hydrated state will favour a higher rate of oxidising metabolism. Analysis of the blood and constitutional features of adult birds gives some indication that the metabolic differences of male and female germs persist in the male and female adults. A calorimetric determination of the energy-value of hundreds of eggs confirmed the reality of what may be called metabolic dimorphism, agreeing with the conclusions reached from studies on the weights of yolks and on yolk analysis, and strikingly consistent with the breeding data. "We could say, if we wished to make merry with our colleagues, the cytologists, that we here get closest to the facts of sex when we *burn* our chromosomes."

Some of the incidental corroborations of Dr. Riddle's thesis are very interesting. Thus females hatched from eggs laid early in the season tend to be more masculine in their sex-behaviour than their own full sisters hatched later in the season. "Several grades of females can be thus seriated according to the season of hatching." Again, the female hatched from the first egg of a clutch is, in a great majority of cases, more masculine than her sister hatched from the second of the clutch. Another sidelight may be found in the frequency of a persistence of the right ovary in birds hatched from eggs which are otherwise known to be most feminine.

Numerous facts converge to the conclusion that "sex and characteristics other than sex, such as fertility and developmental energy, not only bear initial relations to the order of the egg in the clutch, but that sex and these other characteristics are progressively modified under stress of reproductive overwork, until at the extreme end of the season certain aspects of femininity are abnormally or unusually accentuated. In the light of these facts sex reveals itself as a quantitative modifiable character," associated with modifiable metabolic levels.

Dr. Riddle's view of sex, based on experimental results, is akin to the biological interpretation expounded by Geddes and Thomson in "The Evolution of Sex" (1889), that the fundamental difference between maleness and femaleness is a difference in the ratio of katabolic to anabolic processes, and that the determination of sex is to be looked for in factors affecting the rate and the nature of metabolic processes in the germ-cells or in the early stages of development. Dr. Riddle partially recognises the anticipation: "A general classification of male and female adult animals on the basis of a higher metabolism for the one and a lower for the other was indeed made by Geddes and Thomson many years ago. It now seems beyond question that this conclusion of these authors is a correct and important one."

Dr. Riddle's physiological view of sex is in harmony with many experimental results reached by other investigators, as may be illustrated by reference to Baltzer's beautiful experiments on the worm Bonellia, where there is striking dimorphism between the large female and the pigmy male. The newly hatched larvæ are capable of becoming either. If they happen to become attached to the proboscis of an adult female they become males; if they settle into the sand and mud they undergo, quite slowly, further development into females (almost exclusively). If the free-swimming, indifferent larvæ are artificially helped to a connection with the proboscis of an adult female, and then removed at progressively longer periods, the significant result is the production of practically all stages of hermaphroditism. Those

[1] "The Control of the Sex Ratio." By O. Riddle. Journ. Washington Acad. Sci., vii. (1917), pp. 319–56.

first removed become almost perfect females; others with longer and longer periods of attachment become more and more perfect males.

The general idea, then, is that "sexually differentiated organisms, from the first, have had the problem of producing germs pitched at two different metabolic levels." In connection with the establishment of these two metabolic levels (which appear to us to be also illustrated by variational alternatives quite apart from those of sex), the germ-cells have sometimes at least produced two different chromosome complexes. "But, as we have seen, the requisite metabolic level of the germ may be established in the absence of the appropriate chromosome complex, and the sex of the offspring made to correspond with the acquired grade or level of metabolism." Sex is plastic, reversible, quantitative in nature. "Seemingly this can only mean that other hereditary characters are also modifiable." Dr. Riddle has made a very notable contribution towards the solution of a long-standing problem.

NOTES.

THE mastership of Trinity College, Cambridge, is in the gift of the Crown, and to this post, vacant by the recent death of Dr. Butler, Sir J. J. Thomson has been appointed. No fellow of that great house has had a more distinguished career, and his appointment was not unexpected. He is the first layman to hold the office. Three other fellows of the Royal Society are heads of Cambridge colleges, namely, Dr. A. E. Shipley, Christ's; Dr. H. K. Anderson, Gonville and Caius; and Prof. A. C. Seward, Downing. "J. J.," as he is commonly called, was born just over sixty-one years ago, entered Trinity in 1876, was made a lecturer of his college in the same year in which he took his M.A. degree, and shortly afterwards, at the early age of twenty-seven, was appointed Cavendish professor at Cambridge in succession to Lord Rayleigh. His success in developing the Cambridge school of mathematical and experimental physics must be familiar to all readers of NATURE, and there is scarcely any civilised country which has not sent students to work under him in his laboratory. The brilliant researches carried on there were surveyed in NATURE of March, 1913, when Sir Joseph Thomson was the subject of an article in our series of "Scientific Worthies." In 1905 Sir Joseph Thomson was appointed professor of physics at the Royal Institution, and was awarded a Nobel prize for physics in the following year. He was president of the British Association in 1908, and four years later received the coveted distinction of the Order of Merit. In 1915 he was elected president of the Royal Society, and now his academic course is crowned by the headship of the leading college in his University. This is not the place to describe Sir Joseph Thomson's discoveries. It is more interesting to turn to the future. He is a ready speaker, a good talker, has the "saving grace" of humour, is popular, and knows and is known by all physicists and most chemists. He has now a great opportunity, and we predict with confidence that, aided by his wife, his rule in Trinity will add further lustre to his career, and bring university society into ever closer touch with leaders of scientific thought in Europe and America.

PROF. W. W. WATTS, professor of geology at the Imperial College of Science and Technology, has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, and for public service."

SIR NAPIER SHAW, director of the Meteorological Office, has been elected a foreign honorary member of the American Academy of Arts and Sciences, Boston.

WE regret to announce the death on February 7, in his seventy-first year, of Prof. G. A. L. Lebour, professor of geology in Armstrong College (formerly Durham College of Science), Newcastle-upon-Tyne, since 1879, and vice-principal of the college since 1902.

THE Perkin Medal Committee, consisting of members of several chemical societies, has, says *Science*, awarded the Perkin medal for 1918 to Auguste J. Rossi, of Niagara Falls, New York, in recognition of his work on titanium.

THE death is announced, at eighty-six years of age, of Prof. G. P. Girdwood, professor of chemistry in the faculty of medicine of McGill University, Montreal, from 1869 to 1902.

AT the ordinary scientific meeting of the Chemical Society, to be held at Burlington House, W.1, on Thursday, February 21, at 8 p.m., the Hon. R. J. Strutt will deliver a lecture entitled "Recent Studies on Active Nitrogen."

WE learn from *Science* that the Nichols medal for meritorious research in organic chemistry has been conferred on Prof. T. B. Johnson, of the Sheffield Scientific School of Yale University. The medal is awarded annually by the New York Section of the American Chemical Society on the merit of the original communications published in the journal of the society.

THE following officers and other members of council were elected at the annual meeting of the Malacological Society on February 8:—*President*, J. R. le B. Tomlin; *Vice-Presidents*, Rev. A. H. Cooke, A. Reynell, Tom Iredale, and H. O. N. Shaw; *Treasurer*, R. Bullen Newton; *Secretary*, G. K. Gude; *Editor*, B. B. Woodward; *Other Members of Council*, A. S. Kennard, Charles Oldham, G. B. Sowerby, A. E. Salisbury, E. R. Sykes, and W. J. Wintle.

THE officers and ordinary members of council of the Royal Microscopical Society, elected for the ensuing year, are as follows:—*President*, J. E. Barnard; *Vice-Presidents*, E. Heron-Allen, F. Martin Duncan, A. Earland, and R. Paulson; *Treasurer*, C. F. Hill; *Secretaries*, Dr. J. W. H. Eyre and D. J. Scourfield; *Ordinary Members of Council*, A. N. Disney, Dr. R. G. Hebb, T. H. Hiscott, Dr. Benj. Moore, Dr. J. Milton Offord, P. E. Radley, E. J. Sheppard, A. W. Sheppard, Dr. C. Singer, C. D. Soar, J. Wilson, and B. B. Woodward; *Librarian*, P. E. Radley.

THE twelfth award of the Reuben Harvey triennial memorial prize of the Royal College of Physicians of Ireland will be made on July 1 next. The competition is open to all students of the various recognised schools of medicine in Dublin, and to graduates or licentiates of the medical licensing bodies in Ireland of not more than three years' standing. The essays must show original research in animal physiology or pathology, be illustrated by drawings or preparations, and reach the Registrar of the Royal College of Physicians of Ireland, Kildare Street, Dublin, not later than June 1.

MISS EDITH H. MARTYN records from Cheltenham the appearance of a fine peacock butterfly (*Vanessa Io*) on February 8. Though Blomefield, in his

"Naturalist's Calendar," gives February 28 as the earliest date of occurrence of this butterfly near Cambridge, it is not unusual for specimens to be seen in the south of England several weeks earlier. Two peacock butterflies were seen by the present writer near Arundel, Sussex, a fortnight before the date of Miss Martyn's record. They were no doubt insects which had hibernated and had been stirred into flight by the warm sunshine.

AT the anniversary meeting of the Royal Astronomical Society held on February 8 the officers and council were elected as follows:—*President*, Maj. P. A. MacMahon; *Vice-Presidents*, Prof. A. S. Eddington, Dr. J. W. L. Glaisher, Prof. R. A. Sampson, and Prof. H. H. Turner; *Treasurer*, Mr. E. B. Knobel; *Secretaries*, Dr. A. C. D. Crommelin and Prof. A. Fowler; *Foreign Secretary*, Dr. A. Schuster; *Council*, Mr. A. E. Conrady, the Rev. A. L. Cortie, S.J., Dr. J. L. E. Dreyer, Sir F. W. Dyson, Col. E. H. Hills, Mr. J. H. Jeans, Mr. H. S. Jones, Mr. E. W. Maunder, Dr. W. H. Maw, Prof. H. F. Newall, Prof. J. W. Nicholson, and the Rev. T. E. R. Phillips.

THE possibility of producing from home sources, hitherto neglected, a certain proportion of the vast amount of mineral oil and its kindred products, now so vital a necessity to our national existence, has been much discussed for some time past in both the general and technical Press. Particular interest, therefore, is attached to the paper entitled "A New British Oil Industry," by Mr. E. H. Cunningham Craig, Dr. F. Mollwo Perkin, Mr. A. G. V. Berry, and Dr. A. E. Dunstan, to be read at the meeting of the Institution of Petroleum Technologists on February 19, at 8 p.m., at the house of the Royal Society of Arts, Adelphi, W.C.2. The president of the institution, Mr. C. Greenway, will occupy the chair.

THE council of the Paisley Philosophical Institution has decided to initiate a special research section, and to equip a laboratory for the use of members who desire practically to investigate problems of geology and biology. The institution has a practical interest in the well-equipped Coats's Observatory, in which research in astronomy and meteorology is provided for. It possesses, also, an outfit for the encouragement of photography. Members are to be at liberty to join the new section by payment of an additional subscription. The satisfactory equipment of the laboratory will cost money; and this has to be found. The institution has a small reserve fund, but it is proposed to raise a special fund of 150*l*. by subscription, and towards this Mr. Robert Russell, a vice-president, has given 50*l*.

IN a report presented to the Imperial Institute Committee for Australia on the recent work of the institute for the Commonwealth, particulars are given of the results of an investigation into a series of oils prepared during the Australasian Antarctic Expedition and forwarded to the institute by Sir Douglas Mawson. These materials included sea-leopard oil, Weddell seal oil, and penguin oil. The oils have been carefully examined in the Scientific and Technical Department of the Imperial Institute in order to determine their characters in comparison with commercial oils of a similar kind, and have also been submitted to buyers of such oils in the United Kingdom. The oils were of good quality, and could be utilised for the purposes to which commercial seal and whale oils are applied, viz. for soap-making, leather-dressing, burning, etc. There is no doubt that there would be a ready sale for consignments of any of these oils at about the current price of whale and seal oils if they should become available in commercial quantities.

PROF. MAGNUS MACLEAN, of Glasgow, gave the Kelvin lecture to the Institution of Electrical Engineers on February 7. He took for his subject Kelvin as a teacher; and as he was for fifteen years Lord Kelvin's official assistant at Glasgow University, he threw many interesting sidelights on the everyday life of the great physicist. The lecture consisted mainly of extracts from Kelvin's letters to his assistant, generally giving him instructions to carry out researches. They all show intense eagerness to extend the boundaries of our knowledge of physical science and impatience at the length of time requisite to carry out the necessary experiments. Kelvin's experiments on electric fuses in 1886 and on "ampere gauges" (ammeters) in 1888 showed how he almost intuitively knew the difficulties that would arise, and apparently that he never was at a loss for methods of obviating these difficulties. In connection with his ampere gauges, for instance, he suggested that they might be made "dead heat" by means of a dash-pot. His first suggestion for making the latter was a metal plate dipping into a solution of sugar in water contained in a test-tube, as by this means any desired amount of viscosity could be obtained. Prof. Maclean also stated that Kelvin never regarded seriously any suggestions for "rationalising" our system of electric units. In fact, he regarded the proposals as "frivolous nonsense."

IN the old days electricians used to regard a "magneto" as a toy dynamo, and thought that it would be beneath the dignity of a first-rate designer to suggest improvements. Now neither labour nor expense is being spared in order to perfect it. Before the war there were only two or three firms in this country which made magnetos; there are now at least twenty times as many. As most of the pre-war magnetos came from Germany, our manufacturers were hard put to it in the early days of the war, and many of them slavishly followed the well-known design patented by Bosch. Great improvements were soon made by the British engineers in the ignition circuit, and there are now many types of magneto which are greatly superior to the Bosch. There is still a great demand for further improvements, but the engineer finds it difficult to determine whether he has to design for a minimum amount of energy or for a big potential gradient in the sparking-plug, and this hinders progress. The Students' Section of the Institution of Electrical Engineers ably discussed this question at a meeting at Faraday House on February 8, when Mr. R. W. Corkling read a paper on magnetos. Mr. Corkling showed all the latest types of magneto. He gave a full description of the one taken from a Zeppelin brought down in this country in 1916; its finish and accuracy of manufacture left little to be desired, but the design was poor. Mr. James, the vice-chairman of the section, suggested that the problem of "jamming" the ignition circuit of an enemy aeroplane by a suitable wireless method ought not to be an insuperable one; men of science had solved much more difficult problems in the past. There was a large number of youthful electricians present, who all took the greatest interest in the proceedings.

AN account of the life and mathematical work of Giuseppe Veronese is given by Prof. Corrado Segre in the *Atti dei Lincei*, vol. xxvi., (2), 9. Born at Chioggia on May 7, 1854, the son of a small painter, Veronese early showed a taste for art, which he later cultivated as a hobby, but after studying at the technical schools in Chioggia and Venice (where he partly supported himself by copying and giving lessons), Veronese went to Vienna, undertaking work there in connection with the Danube and designs for the exhibition. A year later he went to the Polytechnic at Zurich, study-

ing mechanics at first, and then pure mathematics under Fiedler. Here he became interested in the work of Steiner, and sought to investigate the properties of the Pascal lines of the sixty hexagrams formed by joining up six points in every possible way. In 1876 Veronese asked to study at Rome under Cremona and Battaglini, where he was soon appointed assistant lecturer in projective geometry. His work on the hexagram was published in April, 1877, and some years later the Lincei published two memoirs by him on certain configurations in planes and in space. In 1880–81 Veronese went to Leipzig under Klein, and published an important memoir in German on the geometry of hyperspaces, and this was followed by further writings on this and kindred subjects. In October, 1881, he succeeded to the chair of geometry at Padua, and it is noteworthy that his predecessor, Bellavitis, was a disbeliever in the new-fangled "geometrical aberrations," as he styled the studies in which Veronese revelled. In addition to more advanced work, Veronese was the author of a successful treatise on elementary geometry. He appears, however, to have had a practical side to his character entirely distinct from his more abstruse studies, for he occupied himself assiduously with hydrographical problems with special, but not exclusive, reference to the Venetian lagoons. In addition, he served on the Municipal Council, and in 1904 was nominated Senator, in which capacity he made many important speeches. He was one of the first and most enthusiastic supporters of the war, but unfortunately his health had begun to break down in 1911–12 as the result of influenza, and he died on July 17 of last year.

THE third report of the Committee for the Exploration of the Irish Caves has just been issued by the Royal Irish Academy (Proceedings, vol. xxxiv., Sect. B, No. 3). It deals with the Castlepook Cave, Co. Cork, which was excavated under the direction of the late Mr. R. J. Ussher, and yielded more than 30,000 bones and teeth. A description of the cave by Mr. Ussher himself shows that it originated by the usual widening of joints in the Carboniferous Limestone, and the deposits on the floor consist not only of cave earth (decomposed limestone) and stalagmite, but also of sand and stones introduced by running water. As pointed out by Prof. H. J. Seymour, all the stones are of local origin, while many of those in the Boulder Clay of the surrounding country have been brought from a long distance. It therefore seems probable that the deposits containing the bones of animals which no longer live in Ireland are pre-Glacial. There is no evidence that the cave was ever occupied by man—indeed, it seems to have been always too damp for human habitation; but, as shown by abundance of remains in the lowest layer of the floor, it was at first frequented by a large variety of the brown bear, and, as equally evident from numerous bones and coprolites in the second layer, it then became a den of spotted hyænas. These animals introduced into the cave an immense number of bones of the reindeer and some young individuals of the mammoth. Among them are also numerous remains of the Scandinavian lemming and a new species related to the Arctic lemming. In later deposits there are bones and teeth of domesticated animals, which have been introduced partly by foxes, partly by accidental falls from above. Dr. R. F. Scharff, who describes the mammalian remains, emphasises the importance of the discovery of the cave hyæna in Ireland, and the interest of the proof that it was a contemporary of the reindeer.

THE classification and study of the anaerobic bacteria of war wounds is the subject of a report by Dr. James McIntosh, published by the Medical Research Committee (Special Report Series, No. 12, 1917). Infection of wounds by this class of organisms has been very common in the present war, and some of the resulting complications, such as gas gangrene, are very dangerous. A good deal of confusion and uncertainty has hitherto existed as to the particular micro-organisms involved on account of the great difficulty of isolating them in pure culture. In the investigations detailed in the present memoir Dr. McIntosh has used elaborate precautions to establish really pure cultures as surface growths. This has been accomplished by the use of palladium-black as a means for obtaining anaerobic conditions—a method elaborated by Dr. McIntosh and Dr. Fildes. Some nineteen types of anaerobic bacteria are fully described, of which seventeen were isolated from wounds. The memoir is illustrated with fifteen plates, and Dr. Fildes contributes an account of the principles involved in anaerobic cultivation. The publication of this valuable and important piece of work is particularly opportune at the present time.

MR. GILBERT ARROW, in the *Entomologists' Monthly Magazine* for January, gives a brief account of the life-history of one of the Coccinellid beetles (*Scymnus capitatus*), including what appears to be the first accurate figure yet published of the larva. "It is interesting to note," he remarks, "that before attaining the fully mature condition the freshly developed beetle passes through stages of pigmentation which are represented in allied species of Scymnus."

A NORTHWARD extension of the range of the purple sea-urchin (*Strongylocentrotus lividus*) is recorded in the *Irish Naturalist* for January by Mr. W. F. Johnson, who gives a brief description of specimens taken from the Island of Inishkeel, Co. Donegal. At Bundoran, where this species occurs in some numbers, it lives in cup-shaped hollows excavated in the surface of the rock. The specimens found at Inishkeel seem in no case to have made similar excavations, from which it is inferred that they have but lately established themselves. Both the purple and the reddish varieties were found.

UNTIL now the white-winged black tern (*Hydrochelidon leucoptera*) has been extremely rare in Australia, but during Easter of 1917 it was found in great numbers along the west coast so far south as Fremantle—a thousand miles south of its normal winter range. It would seem that the birds followed the trail of a dragonfly (*Hemianax papuensis*), which, during this time, was to be seen in myriads. On these the birds were feeding. This occurrence is one of quite peculiar interest, not merely to ornithologists, but also to students of migration generally, who will find an admirable summary of the occurrence in the *Emu* for October last, which has just reached us.

THE Ipswich and District Field Club is fortunate in securing for its Journal (vol. v., for 1916, published November, 1917) a paper by Prof. P. G. H. Boswell, dealing with the Palæozoic floor as revealed by borings in East Anglia. Details of wells and borings for water made in Suffolk since 1906 are appended, as a supplement to those recorded in the Memoirs of the Geological Survey.

THE Summary of Progress of the Geological Survey of Great Britain for 1916 includes details of deep borings made for coal and ironstone near Dover and Folkestone, the cores from which have been in large part examined by the officers of the Survey. Mr. Lamplugh records the details of a boring made at Battle in 1907–8 from near the top of the Wealden Ashdown Sand to the base of the Kimmeridge series,

a total depth of 2071 ft. A useful educational section is given, showing our knowledge of the floor of eroded Carboniferous rocks that underlies eastern Kent.

MR. C. A. COTTON, of Wellington, N.Z., contributes to the *American Journal of Science* (vol. xliv., p. 249, 1917) a paper illustrated by numerous diagrams on "Block Mountains in New Zealand." This is in part a summary of his previous work, and is accompanied by an important bibliography. The expository methods of Prof. W. M. Davis are utilised, and fault-scarps, in various stages of maturity, are traced as the margins of block-masses throughout central Otago. The importance of tors as measures of the amount of erosion of a land-surface is usefully pointed out.

SEVERAL changes have been instituted in the Monthly Meteorological Chart of the Atlantic Ocean beginning with the January number for this year. The part which refers to the Mediterranean has been discontinued and replaced by inset maps showing the mean annual rainfall and the mean rainfall of the current month over Nigeria. To the coast line of the great American lakes the results of observations for pressure, air, and sea temperature and currents are added. Among other changes and additions there is a map showing the distribution of specific gravity. The similar monthly chart of the Indian Seas has also undergone some changes, and now includes a large-scale map of the China Sea, showing the distribution of pressure, air, and sea temperature.

THE rainfall of 1917 in the British Isles was about the average, but large areas of deficient rainfall occurred in all parts of the country. According to *Symons's Meteorological Magazine* for January (vol. lii., No. 624) the most important of these areas were in the centre, part of the north, and the south-west of England, all of which had deficiencies of more than 10 per cent. The east midlands of Scotland were also dry, the deficiency exceeding 20 per cent. over an area extending from the Firth of Forth to the Grampians. The southern half of Ireland and the extreme north and the south of Wales had a rainfall below the average. Unusually wet regions included the west and north of Scotland, the north of Ireland, the Yorkshire Wolds, Cardigan Bay, and the London district. August, October, and November showed a general excess of rainfall over the country. May was rather wet in Ireland and June in England, especially locally. February and December were unusually dry, and there was, on the whole, a general deficiency of rainfall during the first seven months of the year.

PART I of vol. xxx. of the Proceedings of the Physical Society of London is exceptionally strong in optical papers. Mr. T. H. Blakesley points out the convenience of representing a simple lens by a point on a plane diagram in which the co-ordinates are the quotients of the two radii of curvatures of the two bounding surfaces by the thickness of the lens at its middle point. Lenses having some particular property are then represented on the diagram by the points on some line which in many cases turns out to be straight. Mr. T. Smith and Miss Dale, of the National Physical Laboratory, show that the mechanically strong triple-cemented objective may with advantage be substituted for the non-cemented doublet of flint and crown glass at present usual in small telescopes. Such triple objectives, it is shown, can be designed with the first-order spherical aberration and coma zero and the second order small, and these conditions do not necessarily limit the lens surfaces to those of small curvature.

WITH reference to the possible risk involved in the use and transportation of celluloid articles, an investigation into the effects of heat upon such articles was carried out by the U.S. Bureau of Standards in 1907. In view of the present interest in nitro-cellulose products it has recently been thought desirable to publish the results, which are now given in Technologic Paper No. 98, issued by the bureau. The chief conclusions arrived at were that when celluloid is exposed to heat, decomposition commences at temperatures in the neighbourhood of 100° C., and above 170° the decomposition takes place with explosive violence. If loss of heat by radiation is prevented, the heat of decomposition at temperatures of about 120° to 135° may raise the temperature of the mass to the ignition point; and momentary contact with bodies having a temperature of 430°—below visible red-heat—may ignite celluloid articles. The rate of combustion was found to be from five to ten times that of paper, pine-wood, or poplar wood of the same dimensions and burning under the same conditions. Nitro-cellulose exists and reacts as such in celluloid, and the rate of its decomposition when heated is not diminished by admixture with zinc oxide (a common ingredient of celluloid products) in proportions up to 20 per cent. There appears to be no good evidence that celluloid articles often inflame spontaneously, or that they are directly explosive under any conditions. The vapours evolved by decomposition are poisonous and extremely combustible, and may be ignited by the heat of decomposition of the celluloid itself. The decomposition is autocatalytic, and while not necessarily explosive, it may readily approach that condition as a limit.

IN the *Journal of Geology*, vol. xxv., p. 629, 1917, Prof. L. V. King, of McGill University, discusses the internal friction and limiting strength of rocks under conditions of stress such as exist within the earth. Taking his data from Adams and Bancroft's experiments on the effect of intense end pressures applied to small rock specimens enclosed in nickel-steel cylindrical jackets, he shows that a simple theoretical treatment of the elastic stage suffices to explain the mode of shearing rupture observed in the rock and the enclosing jackets. His main purpose, however, is to test Navier's modification of Tresca's theory that a stressed solid would commence to flow (without rupture) as soon as the maximum shearing stress exceeded a limiting value K characteristic of the solid; Navier's hypothesis replaced K by $K+\mu N$, where N is the stress normal to the shearing plane, while μ is a coefficient of internal friction. Prof. King concludes, from the work of Adams and Bancroft, that for some kinds of rocks constants K and μ do exist, although the theory does not lead to very accordant values from different sets of experiments. In some cases, while the limit of plasticity certainly increases with the hydrostatic pressure, the internal friction does not seem to be simply proportional to the normal stress; this was particularly so for some of the hardest rocks, such as dolomite, which appear to possess great internal friction. These conclusions have an important bearing on questions of geology and geodynamics. Sir G. Darwin estimated that under the continents of Africa and America the strain must be so great that marble would break under it, though *strong* granite would stand. This was based on the limiting stresses found from ordinary crushing tests, but it now appears that the limiting stress will be much greater at considerable depths, owing to the great hydrostatic pressure. It is suggested that great movements of the earth's crust have mainly proceeded by slow and gradual adjustment, rather than by series of cataclysmal collapses.

In the study of the chemical actions involved in the dissolution of gold by sodium cyanide solutions it is necessary to know the extent of the hydrolysis of the latter, because it has been shown that this is an important factor in the rate of dissolution. An ingenious method for the estimation of the degree of hydrolysis of sodium cyanide solutions has been devised by Messrs. F. P. Worley and V. R. Browne (Chemical Society's Journal for December). A set of three flasks and three test tubes is set up in such a way that a current of air can be aspirated through all six vessels, the flasks alternating with the test-tubes. The latter contain an alkaline solution of sodium picrate; the first flask contains hydrocyanic acid of one concentration, the second the sodium cyanide solution, and the third hydrocyanic acid of a second concentration. The depth of the reddish-brown colour produced in the picrate indicator solution depends on the concentration of hydrogen cyanide vapour in the air current. Consequently, by varying the concentration of the hydrocyanic acid solutions until one is found which gives the same intensity of colour as the sodium cyanide solution, the concentration of hydrocyanic acid which has the same hydrogen cyanide pressure as the sodium cyanide solution is determined. It was shown that the amount of hydrogen cyanide removed from solution is too small to affect the degree of hydrolysis, and that the whole of the vapour was absorbed by one tube of picrate solution.

Messrs. W. O. Robinson, L. A. Steinkoenig, and C. F. Miller have analysed the ashes of a large number of legumes, vegetables, grasses, trees, and bushes to determine whether the rare elements which have been found in certain soils occur in plants which have been grown on those soils. The results, together with analyses of the soils in question, are published in Bulletin No. 600 of the U.S. Department of Agriculture. Spectroscopic quantities of lithium were found in all the plants examined, and rubidium was present in the majority of cases, the quantity of it being larger than that of other rare alkalis. But plants containing 0·01 per cent. or more of rubidium oxide had been grown on soil in which rare alkali minerals are known to occur. Cæsium was detected in the ashes of timothy grass from Mount Mica, Paris, Me., the red raspberry from Beryl Mountain, Acworth, N.H., and the beets from Marlboro, N.H. Cæsium beryls have been found in the first two of these localities. Molybdenum was never detected; chromium and vanadium were occasionally found, though only in traces. Determinable amounts of barium were found in the ash of all the plants examined, and strontium in all except bean seeds. Very small quantities of titanium were present in the ash of all the plants. All the plant ashes analysed, except two, contained aluminium. Pine needles contain an exceptionally high amount of the latter element. The larger the amount of rubidium and cæsium, but not of lithium, present in the soil, the more is absorbed by the plant. There is no evidence that vanadium replaces phosphorus (as phosphoric acid) in its functions in the plant. The authors conclude that of the elements determined none need be considered in fertiliser practice except those commonly used, and sulphur, chlorine, and manganese in some cases. The appendix to the bulletin contains a detailed account of the analytical methods employed.

Messrs. H. Sotheran and Co., 140 Strand, have just issued a catalogue (No. 770) of rare and standard books on exact and applied science, which is of exceptional interest and value. It includes the scientific portion of the library of the late Lord Justice Stirling, and selections from the collections of George Rennie, F.R.S., Samuel Roberts, F.R.S., and other men of science, and gives particulars of a large number of very scarce works. The list is particularly strong in sets of journals of scientific societies. Among many rare volumes we notice the following:—The first edition of the *Opus Majus* of Roger Bacon; the Edizione Nazionale of Galileo's works; Borgo's "Libro de Abacho" (the first edition of the first printed treatise on arithmetic); the first Continental edition of Napier's "Logarithmorum Canonis Descriptio," etc.; the first edition of Gilbert's "De Magnete, Magneticisque Corporibus, et de Magno Magnete Tellure, etc."; the first octavo edition of Newton's "Opticks," with MS. additions and corrections in Sir Isaac Newton's handwriting; and Dalton's "New System of Chemical Philosophy," complete. The catalogue is published at 2*s*. 6*d*. net.

OUR ASTRONOMICAL COLUMN.

Galactic Co-ordinates.—An interesting article on the galactic circle as a plane of reference for star places is contributed to the February number of *Scientia* by Dr. A. C. D. Crommelin. Following a comparison of the more familiar systems of co-ordinates, it is explained that catalogues of stars giving positions with respect to a plane which is independent of the earth's motions would have the great advantage that they would not get out of date as our present catalogues do, as only small corrections for proper motion would be required. The most obvious circle of reference is that provided by the Galaxy, for almost every feature either of distribution or of motion of the various classes of stars is based on the Galaxy as a plane of symmetry. It is difficult to give precision to the definition of the galactic circle, but from a consideration of eight determinations, Dr. Crommelin suggests that the adopted position of the north galactic pole, for the equinox of 1900, should be R.A. 12h. 42m. 37s., decl. $+27^\circ 32'$. It is further suggested that an actual star should be selected to mark the zero of galactic longitude, say α Cygni, which has an extremely small proper motion. The general adoption of some such scheme has been widely advocated, and will doubtless sooner or later be realised.

Molecular Scattering of Light.—In a paper communicated to the Astronomical Society of France (*L'Astronomie*, January), Prof. Ch. Fabry gives an account of Lord Rayleigh's explanation of the blue coloration of the sky, and announces that the theory has been experimentally verified in his laboratory at Marseilles by M. Cabannes. Prof. Fabry suggests that several hitherto mysterious phenomena in the heavens may possibly be explained as effects of this scattering of light by gaseous molecules. In the case of the solar corona, for example, the portion of the luminosity which gives a continuous spectrum does not necessarily imply the presence of solid or liquid particles, but may be attributed to the diffusion of photospheric light by molecules of truly gaseous coronal matter. A density of only one-thousand-millionth part of that of atmospheric air would suffice to account for the observed intensity of the coronal light, and the polarisation of the light would be simply explained, as in the case of the light of the sky. A part of the luminosity of the tails of comets may be explained in a similar manner, and in this case the density must be less than one milligram per 1000 cubic metres, as otherwise the luminosity would be greater than any which has ever been observed. Other possible effects of molecular scattering are also suggested. It may be added that Prof. R. J. Strutt has also succeeded in observing the scattering of light by dust-free air in a laboratory experiment with artificial illumination (Nature, October 25, 1917).

LEEDS ASTRONOMICAL SOCIETY.—The Journal and Transactions of this society for the year 1916 has been received. The number of members was fifty-two, and in view of the prevailing conditions, an average attendance of fourteen may be taken as an indication that the meetings continued to be interesting and helpful. Numerous observations of interest are recorded, and among the contributed papers, one by the Rev. I. Carr-Gregg on "The Invisible Universe," and another on "Sir William Herschel," by Miss C. A. Barbour, call for special mention. The editor is Mr. C. T. Whitmell, who has also made numerous contributions.

WAVE-LENGTHS OF HELIUM LINES.

ON account of its great intensity and the convenient distribution of the lines, the spectrum of helium furnishes a valuable source of standard wave-lengths in spectroscopic and optical work. A new series of determinations of the wave-lengths of the brighter lines which has been made by Mr. P. W. Merrill at the U.S. Bureau of Standards, Washington (*Astrophysical Journal*, vol. xlvi., p. 357, December, 1917), will therefore be generally welcomed. The highest possible precision has been aimed at, and as lines belonging to all the six series which constitute the spectrum of helium were included in the measurements, the new wave-lengths will also provide valuable data for computations of theoretical interest.

An interferometer of the Fabry and Perot type was used, and nine of the lines were compared directly with the fundamental standard—the red line of cadmium—by photographing the helium and cadmium spectra simultaneously on the same plate. Other wave-lengths were then determined from photographs of the helium spectrum alone. The adopted values for the twenty-one lines measured are given in the appended table, which also includes the values given by previous observers. The values given by Lord Rayleigh (two sets) and Eversheim were derived from interferometer observations, but those by Runge and Paschen were determined in the more usual way from grating photographs; the latter have been corrected from Rowland's scale to the international scale in order to make them directly comparable with the other values.

Wave-lengths of Helium Lines (in I.A.).

Bureau of Standards	Rayleigh *a*	Rayleigh *b*	Eversheim	Runge and Paschen
2945·104				106
3187·743				701
3613·641				641
3705·003				007
3819·606				605
3888·646				638
3964·727				727
4026·189				192
4120·812				821
4143·759				766
4387·928				934
4437·549				549
4471·477	(478)	480	493	475
4713·143	(171)	142	154	074
4921·929	925	928	922	919
5015·675	680	678	683	556
5047·736				641
5875·618	616	623	639	650
6678·149	144	147	151	14
7065·188	189	197	207	22
7281·349				53

In the case of double lines the wave-lengths are those the stronger components. From the general agreement of individual determinations it is considered probable that the error is in no case so much as 0·003 A., and that in most cases the errors are smaller than that amount. It is shown that the Kayser and Runge formula for spectral series, based upon three consecutive lines, will not reproduce accurately even the next member in any one of the six helium series.

THE CORAL-REEF PROBLEM.

FROM time to time recent work on the topography of coral-reefs has been referred to in NATURE, and the existence of submarine platforms from which atolls and encircling reefs rise has been very generally demonstrated. Prof. R. A. Daly regards these platforms as wave-cut plains, produced from coral banks and volcanic isles when the level of oceanic waters was lowered by ice-accumulation in Glacial times. The melting of the ice caused a general submergence of the platforms and of the adjacent coasts, giving rise to drowned valleys and all the features that have been attributed to a subsidence of the ocean-floor. The existing coral-reefs are thus for him post-Glacial, and grew up on the submerged platforms when warmer conditions were renewed.

In a summary of his views in *Scientia* (vol. xxii., p. 188, 1917) Daly points out that flat, reefless banks occur "in every ocean, inside and outside the tropical belt . . . covered with 45 to 100 metres of water." He urges that the inner walls of reefs are not well graded to the floors of the lagoons, and that the upper wall thus indicates a rise of water-level (whether we attribute it to flooding or subsidence) since the formation of the level inner floor. He believes that this floor is part of the platform, and is not due to infilling, though it is not clear why he should demand "millions of years" for such deposition within the wall (compare also his paper on "A New Test of the Subsidence Theory of Coral Reefs," Proc. Nat. Acad. Sci., vol. ii., p. 664, 1916). He holds that "the mean depths of water above the flat floors of wide lagoons are nearly equal to the mean depths found on reefless banks," and that there is a close similarity of depth in the greater lagoons throughout the reef areas of the Pacific and Indian Oceans. Daly regards the reefs as "peripheral growths on wave-cut platforms," those nearer the centres of the platforms having been extinguished by mud and sand swept over the shoals.

On the other hand, Prof. W. M. Davis, in a series of critical papers, based on a recent visit to the Pacific isles, has greatly strengthened the Darwinian view. Thanks largely to his reasoning, even those who cannot find evidence for a general subsidence of ocean-floors are inclined to invoke block-faulting to explain the drowning of certain areas. Davis ("A Shaler Memorial Study of Coral Reefs," *Amer. Journ. Sci.*, vol. xl., p. 223, 1915) urges that if the lagoon floor is part of a wave-eroded plain from which the reefs rise, the sea would have cut cliffs in the surviving volcanic isles, the tops of which should appear as truncations of the spurs that bound the subsequently drowned valleys. Such cliffs occur in Tahiti ("Clift Islands in the Coral Seas," Proc. Nat. Acad. Sci., vol. ii., p. 284, 1916), but are very exceptional features. Davis regards them as emphasising the general absence of cliffs, even if they "are the work of abrasion during the lowered sea-stands of the Glacial period" ("Problems Associated with the Study of Coral-Reefs," *Sci. Monthly*, vol. ii., p. 564).

Davis, in his three papers in the *Scientific Monthly* (1915) and elsewhere, lays stress on the mature forms of the valleys in the reef-encircled isles as indications of their antiquity. These valleys cannot have been

deepened and widened to their present condition during the relatively short epoch of glacially lowered sea-level. The embayed shores, first used by J. D. Dana as a confirmation of Darwin's subsidence-theory, have none of the characters of recently dissected land. Another point firmly brought forward is the unconformity between the reefs and the floor from which they have grown upward. That floor may be seen, for instance, beneath elevated fringing reefs in the New Hebrides. It has, at some epoch, been subject, not to marine planing, but to subaerial denudation. At Havannah harbour in Efate it must have stood above the sea before the corals grew. The joint evidence of the drowned valleys with their mature forms and of the unconformity of the reefs on an old land-surface points very strongly in favour of Darwin's views. Efate and Oahu in the Hawaiian Islands furnish instances of oscillatory movements, and some authors have held these to be incompatible with a broad system of subsidence. Davis justly styles this objection as "the most singular of all." Finally, the inequality of the depths to which drowning has taken place in adjacent regions is a powerful argument against ascribing the submergence to an increase of water in the sea. Davis, with characteristic width of outlook, believes that "some combination of regional subsidence with Glacial changes of sea-level—or with changes of sea-level caused by movements of the sea-bottom—is worthy of careful consideration as being probably nearer the truth than either process taken alone." But his reasoned conclusion is that subsidence has played by far the greater part.

In a still more recent paper Davis deals with the Queensland platform ("The Great Barrier Reef of Australia," *Amer. Journ. Sci.*, vol. xliv., p. 339, 1917), which he believes to be due in large measure to coral-reef agencies, which produced a mature reef-plain before the subsidence occurred that gave rise to the present barrier reef and the embayment of the coast.

GRENVILLE A. J. COLE.

A BACTERIAL DISEASE OF CITRUS.

DR. ETHEL DOIDGE, mycologist to the Department of Agriculture of the Union of South Africa, who is becoming well known for her researches into the bacterial diseases of plants, is to be congratulated on the excellent piece of work which is described in detail in an article on "A Bacterial Spot of Citrus."[1] At a time when research in phytopathology is largely at a standstill, it is refreshing to read of such ably conducted scientific investigations in our Colonies as these are.

The citrus "spot" is a disease of economic importance in the citrus orchards of the Western Province of the Cape, and attacks not only the fruit, but also the leaf and the branch of the tree. The fruit is disfigured and ultimately destroyed, while the attacks on the tissues of the stem cause very commonly gummosis in the spring.

The cause of the disease was ascertained to be a species of Bacillus new to science, *B. citrimaculans*, A comparative table is given of the characters of this and the two organisms known to attack the citrus in America, viz. *Bacterium citriputeale* and *Pseudomonas citri*. The description of *B. citrimaculans* given by the author, together with its full "group number," may be held up as a model to be followed by workers in this field. The opinion is expressed that very probably the organism is a soil bacillus, which first invaded rotting fruits lying on the ground, and has now taken on a parasitic habit. The organism loses its virulence rather rapidly when cultivated on artificial media. The most frequent method of infection is through wounds, and the author considers the possibility of stomatal infection an open question at present. While preventive measures are not discussed, it is pointed out that any improvement in the sanitation of the affected orchards would doubtless prove beneficial. Since it was found that the organism is very sensitive to copper sulphate, it is suggested that spraying with Bordeaux mixture should be tried.

E. S. S.

[1] *Annals of Applied Biology*, vol. iii., January, 1917, pp. 53-81, with 10 plates.

THE FLORA OF THE SOMME BATTLEFIELD.[1]

THE ground over which the Battle of the Somme was fought in the late summer and autumn of 1916 rises gradually towards Bapaume, and at the same time is gently undulating, with some well-marked branching valleys initiating the drainage system of the area. Before the war the land was for the most part under cultivation, but on the highest levels there were large areas of woodland, such as High Wood and Delville Wood, now shattered and destroyed.

During last winter and spring all this country was a dreary waste of mud and water, the shell-holes being so well puddled that the water has remained in them, and even in the height of the summer there were innumerable ponds, more or less permanent, in every direction.[2]

The underlying rock is everywhere chalk with a covering of loam of varying thickness. As a result of the bombardment the old surface soil has been scattered and the chalk partially exposed. One effect of the shelling, however, has been to disintegrate the underlying chalk and produce a weathering effect which has been accentuated by the winter rains, snow, and frost. A general mixing of chalk, subsoil, and scattered top soil and also a rounding of the sharp edges have taken place, so that instead of the new surface soil being sterile, the shelling and weathering have "cultivated" the land. That this is so is proved by the appearance of the Somme battlefield during the past summer.

Looking over the devastated country from the Bapaume Road, one saw only a vast expanse of weeds of cultivation which so completely covered the ground and dominated the landscape that all appeared to be a level surface. In July poppies predominated, and the sheet of colour, as far as the eye could see, was superb; a blaze of scarlet unbroken by tree or hedgerow. Here and there long stretches of chamomile (*Matricaria chamomilla*, L.) broke into the prevailing red and monopolised some acres, and large patches of yellow charlock were also conspicuous, but in the general effect no other plants were noticeable, though a closer inspection revealed the presence of most of the common weeds of cultivation, a list of which is given below.

Charlock not only occurred in broad patches, but was also fairly uniformly distributed, though masked by the taller poppies. Numerous small patches were, however, conspicuous, and these usually marked the more recently dug graves of men buried where they had fallen. No more moving sight can be imagined than this great expanse of open country gorgeous in its display of colour, dotted over with the half-hidden white crosses of the dead.

In all the woods where the fighting was most severe not a tree is left alive, and the trunks which still stand

[1] Abridged from an article by Capt. A. W. Hill, Assistant Director, Royal Botanic Gardens, Kew, in the *Kew Bulletin of Miscellaneous Information*, Nos. 9 and 10, 1917, by permission of the Controller of H.M. Stationery Office.

[2] For a description of the battlefield shortly after the fighting Mr. John Masefield's recently published book, "The Old Front Line" (Wm. Heinemann), should be read.

are riddled with shrapnel and bullets and torn by fragments of shell, while here and there unexploded shells may still be seen embedded in the stems. Aveluy Wood, however, affords another example of the effort being made by Nature to beautify the general scene of desolation. Here some of the trees are still alive, though badly broken, but the ground beneath is covered with a dense growth of the rose-bay willow herb (*Epilobium angustifolium*) extending over several acres. Seen from across the valley, this great sheet of rosy-pink was a most striking object, and the shattered and broken trees rising out of it looked less forlorn than elsewhere.

The innumerable shell-hole ponds present many interesting features to the biologist. In July they were half-full of water, and abounded in water beetles and other familiar pond creatures, with dragonflies flitting around. In nearly every shell-hole examined, just above the water-level, was a band of the annual rush (*Juncus bufonius*, var. *gracilis*), and this plant appeared to be confined to those zones where the ground was relatively moist, and to occur nowhere else. With the Juncus, and often growing out of the water, were stout plants of *Polygonum persicaria*, and water grasses, not in flower, were often seen spreading their leaves over the surface of the pools.

In the battlefield area not only were the common cornfield weeds to be seen, but here and there patches of oats and barley, and occasionally plants of wheat, sometimes apparently definitely sown, perhaps by the Germans, though more often the plants must have grown from self-sown seeds of crops that were on the land before the war. Here and there, too, could be seen opium poppies representing former cultivation and remnants of battered currant and other bushes which alone remained to show where once had been a cottage garden. Both weeds and corn afford good evidence that the soil has not been rendered sterile by the heavy shelling, but how and when the land can be brought into a fit state for cultivation are questions not easily answered.

On the banks and sides of the roads traces of the old permanent flora still remain, and perennial plants, such as *Scabiosa arvensis*, *Eryngium campestre*, *Galium verum*, chicory, *Centaurea scabiosa*, *Cnicus acaulis*, and other characteristic chalk plants were occasionally seen.

The clothing of this large tract of country with such a mass of vegetation composed almost entirely of common annual cornfield weeds is remarkable when one remembers that it has been the seat of encampments, and for the most part out of cultivation since the autumn of 1914. It is well-nigh impossible that such masses of seed can have been carried by wind or birds to cover these thousands of acres, and the plants must therefore have grown from seed lying dormant in the ground. No doubt in the ordinary operations of ploughing and tilling of the ground in years before the war much seed was buried which has been brought to the surface by the shelling of the ground and subsequent weathering. In this connection the presence of charlock on the more recently dug graves, where the chalk now forms the actual surface, is of interest, since it adds further proof of the longevity of this seed when well buried in the soil.

List of Plants.

Delphinium Ajacis, Reichb., larkspur; *Papaver Rhoeas*, L., poppy; *Fumaria officinalis*, L., fumitory; *Raphanus Raphanistrum*, L., white charlock; *Brassica sinapis*, Vis., yellow charlock; *Matricaria chamomilla*, L., chamomile; *Centaurea cyanus*, L., flower; *Cnicus arvensis*, Hoffm., thistle; *Sonchus* L., corn sowthistle; *Sonchus oleraceus*, L., sowthistle; *Specularia speculum*, A. DC., looking-glass flower; *Anagallis arvensis*, L., scarlet pimpernel; *Myosotis arvensis*, Hoffm., forget-me-not; *Convolvulus arvensis*, L., small bindweed; *Solanum nigrum*, L., nightshade; *Plantago major*, L., etc., plantain; *Veronica hederaefolia*, L., etc., speedwell; *Galeopsis ladanum*, L., hemp-nettle; *Chenopodium album*, L., goosefoot; *Atriplex patula*, L., orache; *Polygonum aviculare*, L., knotgrass; *Polygonum persicaria*, L., persicaria; *Rumex obtusifolius*, L., dock; *Euphorbia helioscopia*, L., sun spurge; *Mercurialis annua*, L., dog's mercury; *Juncus bufonius*, L., var. *gracilis*, St. Amand rush. A few grasses and occasional plants or patches of oats, barley, and wheat.

COAL CONSERVATION AND ELECTRIC POWER SUPPLY.

WE referred in our issue of January 3 to the interim report on electric power supply in Great Britain prepared by the Coal Conservation Sub-Committee of the Reconstruction Committee. Dr. C. Addison, Minister of Reconstruction, states in an introductory note that the important issues affecting municipalities and public bodies raised in the report will be explored in all respects by the Government before any action is proposed to Parliament upon the subject.

The report deals, first, with the extent to which conservation of coal could effect economy in the production of motive power and other forms of energy used for industrial purposes in this country; secondly, with the expansion of industry which should result, in the way of new manufactures, from the proper use of the coal so saved; and thirdly, with the steps necessary to attain these objects.

It contains many valuable tables and other details, and the following summary of the chief points dealt with and the conclusions arrived at:—

(1) The coal consumption involved in the production of motive power in the United Kingdom amounts at the present time to 80,000,000 tons per annum, equivalent in value to, say, 40,000,000*l*. at pit-head.

(2) In the industrial reorganisation which must take place on the termination of the war the further development of power is of great importance. The present use of motive power per employee is only about half that in the United States of America. Large quantities of electrical power will be required for the development and carrying on of new processes not at present undertaken in this country. Processes involving some millions of horse-power at present worked in America, Norway and Sweden, Germany, etc., can be profitably carried on, and, having in view the desirability of making all essential products in the Empire, should be carried on in this country.

(3) It is only by largely increasing the amount of power used in industry (by two or more times) that the average output per head (and as a consequence the wages of the individual) can be increased. The pre-war earning power, or wages, of each individual was far too low.

(4) Power may be most efficiently applied to industry by the medium of electricity.

(5) The economical generation of the electrical energy so required is thus of great importance, and the first question to be answered is whether the best economy can be obtained by each works or municipal area providing for its own individual needs, or by a comprehensive scheme.

(6) Technically and economically the electrical energy can be best provided by a comprehensive system, as may be amply proved from experience gained in those

parts of the world where such systems are in existence, notably in Chicago (Illinois), on the north-east coast of England, on the Rand, and in certain industrial districts of Germany. Power production in large super-plants, with generating machines of 50,000 h.p. or more, will not only be far more economical than in a large number of smaller plants, but will also ultimately involve great economies of capital by securing a better load and a more effective use of the plant. Such super-plants, if suitably situated on large sites, would make it possible—so far as it was economical to do so—to extract the by-products in the shape of oils, motor spirit, etc., from the coal before using it as fuel, thus avoiding to a large extent the necessity of importing them.

(7) The super-plants would feed into the main trunk distribution system, which must be laid down throughout the country. For this purpose the country should be divided into some sixteen districts, throughout each of which there should be a standard periodicity and main trunk voltage.

(8) This main trunk distribution system would collect any waste power available wherever situated and deliver it where it could be profitably used. It would also, by saving the cost of transport, make it commercially possible to bring to the surface much coal at present wasted and left in the pit which, under the new conditions, would be turned into electrical energy at or near the pit-head.

(9) If power supply in the United Kingdom were dealt with on comprehensive lines and advantage taken of the most modern engineering development, the saving in coal throughout the country would, in the near future, amount to 55,000,000 tons per annum on the present output of manufactured products.

(10) If the coal so saved were used for the production of further power it would be possible to generate continuously not fewer than 15,000,000 horse-power, which would more than compensate for the absence of large water powers in this country and admit of the manufacture here of many products which are at present made only in America and on the Continent.

(11) The development of such a power system may be likened to the development of the railways of a country, and it is just as impossible to secure economical power generation and supply by each municipal area working independently, which is the position to-day, as it would be to have an efficient railway system if each municipal area owned its own lines, and long-distance transport were provided for by running-power agreements. History shows that in the early stages of railway development in this country exactly the same process of amalgamation had to be gone through.

(12) The present system of electrical power distribution throughout the country, which is undertaken by more than 600 authorities in as many separate districts, is technically wrong and commercially uneconomical. The present average size of a generating station is only 5000 horse-power, or about one-fourth of what should now be the smallest generating machine in the power station. The "Power Act" legislation inaugurated some fifteen years ago has not had the desired result on account of the restrictions imposed upon the power companies.

(13) A national system of electric power supply would greatly facilitate the electrification of railways with its attendant advantages. save large sums of money at present spent on the transport and distribution of coal, and bring within reach of the community as a whole the great benefits of an increase in the use of electricity for domestic purposes, advantages which, taken together, are perhaps of more value than the direct coal-saving.

PHYSICAL SCIENCE AND THE ART OF EXPERIMENT.[1]

THE exigencies of the war had seriously impeded the work of the Physical Society, as of all our scientific institutions. Many members were at the front; many others were busy on war work, and there was little time available for normal scientific pursuits. Since his predecessor's address, the scientific community had been stirred to an extent which he thought was unnecessary by the passing of the Daylight Saving Act. Scientifically the thing was a sham, and as such was naturally distasteful to us; but the community at large was not scientific, and had a very vague notion of the meaning of time. In the stress of war people had realised the desirability of starting the day earlier to save, not daylight, but paraffin and gas, and the simple operation of putting all the clocks wrong, though hateful in principle, did not disturb the public at all.

In reference to the question of the metric system, this was important in relation to education. The reason why English schools were so backward in mathematics was that so much of the available time had to be devoted to memorising tables of weights and measures and similar medieval relics.

Another matter of public importance was the recognition of science as an element of general education. It is sometimes urged that our officials need not be scientific, because they can get all the scientific advice they want. But they may not know when they require it, or appreciate the force of it when they get it. He might instance in this connection the wasteful method of street darkening which still prevails after three years. The annual trouble with frozen water pipes was another example of the general ignorance of scientific principles. Burst pipes were unknown in really cold countries, where the elements of common sense were allowed to prevail.

All his own contributions to physical science had been experimental, and some words on the art of experiment might not be out of place. In order to succeed as an experimentalist it was necessary to find by personal experience how as many materials as possible behave under as many conditions as possible, and this can only be done by one who will practise every art and use every tool and instrument that he can. While endeavouring at first to imitate the practices of the professional mechanic and acquire as much of his skill as possible, the experimentalist must not be bound by tradition and custom in his methods. It is the slavery to tradition and practice that makes the assistance of the professional so tiresome to the experimentalist. In this connection a saying of Fresnel had greatly impressed him—"If you cannot saw with a file and file with a saw you will be no use as an experimentalist," or words to that effect. He had made it his business to use every tool and to handle every material that he could. On one occasion he had had the somewhat rare opportunity of handling five or six large uncut diamonds, each as big as a walnut. Glass-blowers are familiar with the difference in the contact of freshly blown bulbs and of bulbs some time blown; but the contact of diamonds was unlike either. When brought lightly into contact they emit a curious squeaking note of possibly 2000 vibrations per second. This meant that the diamonds were bouncing with slowly diminishing excursions of 1/80,000 of an inch approximately, a phenomenon only possible with a material of such perfect elasticity or hardness. It was possible that a test of this kind might be useful for discriminating between the hardness of the harder materials. The whole question of what hardness was, and if, indeed, it were really

[1] Abstract of the presidential address delivered to the Physical Society January 25 by Prof. C. V. Boys, F.R.S.

a definable quantity having definite dimensions, was one to which the attention of physicists could profitably be devoted. Another such question was that of the oiliness of lubricants. This appeared to depend on something other than viscosity. Animal and vegetable oils lubricated better than mineral oils of the same viscosity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. W. BOXWELL has been elected professor of pathology and bacteriology in the schools of surgery of the Royal College of Surgeons in Ireland.

A RESEARCH scholarship in mental affections has been instituted at the Western Asylums' Research Institute, Glasgow. Its annual value will be 250*l*., but no appointment will be made during the war.

THE Board of Education announces, in Circular 1026 of February 5, that after this year it will discontinue to hold its general examinations in science and technology. The higher general examinations will be held this year for the last time, and will be conducted in accordance with the "Regulations and Syllabuses for Examinations in Science and Technology, 1915," so far as they are still applicable. This intention to discontinue these general examinations was announced in the prefatory note to the 1915 regulations, and the decision was arrived at after consultation with representative educational and administrative bodies directly interested in the examinations. The present announcement marks the final stage in the gradual elimination of the personal examination of students in its classes by the Board. In 1912 the old elementary stage examinations in science, instituted by the now defunct Science and Art Department, were discontinued, and lower and higher examinations took the place of elementary, advanced, and honours stages. In 1909 the special examinations, which had for many years been held for young students attending day classes in science, were discontinued, as for some years the number of papers worked at day examinations had steadily diminished as the conditions of work in secondary schools improved. It is reasonable to hope that the abolition of these official examinations will strengthen the development of initiative of local education authorities and encourage them to promote schemes of instruction designed to meet local requirements.

THE main measure to be brought forward in the eighth session of the present Parliament, opened by the King on Tuesday, is the Education (No. 2) Bill. The British Science Guild has just circulated a memorandum in which cordial approval is expressed of the provision made in the Bill for the following:—(1) The general development and organisation of all forms of education other than elementary; (2) practical instruction for all elementary-school children, provided that such teaching does not involve direct instruction for a trade; (3) continuation schools and compulsory attendance thereat for 320 hours per annum; (4) co-operation of local education authorities, particularly by means of the formation of federations, chiefly because many local education authorities are obviously unable to deal adequately with higher education, *e.g.* university and higher technological work and the training of teachers; (5) the removal of the 2*d.* rate limit for higher education in county areas; (6) abolition of exemption from attendance at school between the ages of five and fourteen; (7) further restrictions as to employment of children; (8) school holiday camps, centres for physical training, playing-fields, school baths, school swimming-baths, etc.; (9) the extension to secondary schools and other provided schools of the powers and duties of local education authorities respecting medical supervision and treatment; (10) aiding teachers and students in carrying on research; (11) the collection of information respecting schools and educational institutions not in receipt of grants from the Board of Education. The British Science Guild recommends that provision be also made in the Bill (*a*) to compel local education authorities to provide nursery schools in those districts where the Board of Education deems such schools necessary; (*b*) for the inspection, by an approved authority, of all schools not now liable to inspection, whether a request for inspection is made by the school authorities or not; (*c*) for the adequate registration of all schools and other educational institutions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 31.—Sir J. J. Thomson, president, in the chair.—A. **Mallock**: The growth of trees. An account is given of some recent observations of the growth of trees. The observations consisted in the measurement, at short intervals of time, of the variation of the girth of the trees at a height of 4 ft. or 5 ft. above the ground. The measures were made by an "interference" method, which is described. The results showed a well-marked daily period in the variation of girth, different for different species of tree, but in all cases having a maximum at night and a minimum shortly after noon. Diagrams of sets of observations, each extending over several days, are included, showing the growth of a black poplar, an oak, and a Douglas fir. From twenty to thirty readings were taken in the course of each twenty-four hours.—Prof. B. **Moore** and T. A. **Webster**: Action of light rays on organic compounds and the photosynthesis of organic from inorganic compounds in presence of inorganic colloids. The results are recorded under three sections:—(*a*) Photosynthesis by inorganic transformers; (*b*) action of sunlight and of ultra-violet light upon concentrated solutions of formaldehyde; (*c*) the general formation of formaldehyde by the action of light upon organic substances of biochemical origin. In the concluding section a general reversible reaction is described as a result of which formaldehyde rises in all intense reactions of light upon substances of biochemical origin. This reaction in presence of excess of light is an interesting reversal of the process by which all organic matter has been built up from inorganic sources. The bearing of this process upon the germicidal action of sunlight, and upon the destruction of living organisms by ultra-violet light, is discussed, and it is pointed out that the simple organic products so formed are incompatible with the life-processes of living organisms and so lead to their destruction. Taking such a reaction as travelling in the reverse direction, it is shown that the building up of organic matter from inorganic must have been a necessary precedent to any existence of living organisms on the earth, and that all accumulations of reduced substances possessing stores of chemical energy must have arisen in this manner from storage of the energy of sunlight.—Capt. W. J. **Tulloch**: The isolation and serological differentiation of *Bacillus tetani*. (1) More than one variety of non-toxic endosporing bacillus resembling *B. tetani* in morphological characters can be recovered from wound-exudates in cases of the disease. (2) There are at least three different types of toxic *B. tetani.* (3) The "U.S.A. type" of the bacillus—that commonly used for the preparation of antitoxin—is not frequently obtained from wound-exudates in cases of the disease occurring among men who have received prophylactic inoculations of antitetanic serum. (4) Culture in a selective medium, followed by agglutination

of the washed growth, in presence of the three-type sera, gives valuable information. It is, however, apparently not so delicate a test for the presence of *B. tetani* as is animal inoculation after culture of the wound-exudate.—Dr. J. **Brownlee**: An investigation into the periodicity of measles epidemics in the different districts of London for the years 1890–1912. In a previous paper it was found that during the years investigated the chief epidemic periodicities were respectively 87, 97, 109½, and 114 weeks, the most marked period being that of 97 weeks. It is found now that the epidemic with the 87 weeks' period occurs solely south of the Thames, where it is a very marked phenomenon; that the epidemic with the 97 weeks' period, while very marked in the whole of London, is especially marked in the western district; that the epidemic with the 109½ weeks' period is present throughout London with the exception of the east, but is most marked in the western districts; while that with the 114 weeks' period is most marked in the central districts and least present in the eastern districts. The most important fact found, however, is that the epidemics of different periods have special phenomena of their own. In the case of the chief period, that of 97 weeks, the epidemic practically breaks out synchronously in the whole city. In the case of the epidemic with the 87 weeks' period a quite different phenomenon is found, the permanent seat of this epidemic being St. Saviour's or Bermondsey, whence the disease spreads to the neighbouring districts. With regard to the period 109½ weeks, there is evidence that, in both, the conditions just described exist, this epidemic breaking out synchronously in several districts and extending from these to neighbouring districts.

Röntgen Society, February 5.—Capt. G. W. C. Kaye, president, in the chair.—Dr. G. B. **Batten**: A simple method of obtaining "static currents" from an induction coil. One pole of the secondary winding is earthed, while the other is connected, through a series spark-gap and a series condenser, to the patient, who is insulated from earth. The function of the condenser is that of a high resistance, and the apparatus is most effective when employed with the old type of coil with a long and fine secondary winding. The main advantages of the apparatus are that the method is not affected by a damp atmosphere, and its cost is small. Suitable adjustment of the spark-gaps enables any of the six usual methods of application of static electricity to be given.—E. E. **Burnside**: A mobile Snook apparatus. This is constructed on the same principle as the larger pattern hitherto in use, but is made in a more compact form by reducing the maximum spark-gap to 7 in. Mr. Burnside also showed a small transformer constructed for employing the continuous-current main supply to heat the spiral of the Coolidge tube. A small rotary converter changes the direct current into alternating current, which is stepped down to 12 volts by the static transformer. The secondary is well insulated from the rest of the apparatus, and regulation of the filament current is obtained by a variable choke-coil in the primary circuit of the transformer.

MANCHESTER.

Literary and Philosophical Society, February 5.—Mr. W. Thomson, president, in the chair.—Capt. L. **Munn**: Ancient mines and megaliths in Hyderabad. During his thirteen years' experience as Inspector of Mines to the State of Hyderabad, Capt. Munn discovered large numbers of ancient gold and copper mines, many of them of great depth and extent, of which no remembrance has persisted among the people. These mines, as well as the old diamond pits, show the association with megalithic monuments to which Perry directed the attention of the society two years ago; but Capt. Munn's discoveries are of peculiar importance, because Perry was not aware of the presence of ancient gold mines in Hyderabad, although he attached primary importance to gold as the chief attraction of the megalith-builders in other parts of the world. Capt. Munn also discussed the interesting problem of the ancient iron and steel workings in Hyderabad.—Prof. G. Elliot **Smith**: The origin of early Siberian civilisation. At least as early as 3000 B.C. the people who developed Sumerian and Elamite civilisations at the head of the Persian Gulf were already exploiting the country east of the Caspian for copper, and probably turquoise and jade also. It is highly probable that somewhere in the neighbourhood of Meshed the art of making bronze was discovered. The earliest prospectors came from the shores of the Persian Gulf, and had already credited pearls with certain remarkable magical properties. The fact that the special appreciation of jade by the Chinese is due to the mineral being credited with the same powers of life-giving, birth-promoting, corpse-preserving, and luck-bringing as the pearl acquired on the shores of the Erythræan Sea affords conclusive evidence that the incentive to work jade did not originate in China, as Laufer believes, but came from the Khotan-Kashgar region, where the mineral acquired its peculiar virtues by transference from the pearl, the legends concerning which were brought to Turkestan by miners from the south. The inspiration of the early civilisations of both Central Asia and China came directly from Turkestan, which in turn was influenced early in the third millennium B.C. by miners from the Erythræan coasts exploiting its gold and copper and its precious stones. Some centuries later, when bronze came into use, the deposits of tin in Transcaspiana probably attracted men from all parts of the then civilised world; and the effect of this was that to the Babylonian influence in Turkestan and Central Asia was added that of the Mediterranean area.

PETROGRAD.

Academy of Sciences, December, 1917.—V. I. **Palladin**: The influence of wounds on plant respiration.—V. I. **Pavlov**: Investigations on the luminescence of mercury vapour under the action of low-velocity electrons.—N. A. **Abramenko**: Sugar-beet cultivation by the peasants of the Governments of Poland.

BOOKS RECEIVED.

Memento Oppermann à l'Usage des Ingénieurs, etc. Pp. 268. (Paris and Liège: Ch. Béranger.) 6 francs.

The Wonders of Instinct. By J. H. Fabre. Translated by A. Teixeira de Mattos and B. Miall. Pp. 320. (London: T. Fisher Unwin, Ltd.) 10*s*. 6*d*. net.

Late Cabbage from Seed until Harvest: also Seed Raising. By E. N. Reed. Pp. xiii+131. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Soil Biology. By Dr. A. L. Whiting. Pp. ix+143. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

School Entomology. By E. D. Sanderson and L. M. Peairs. Pp. vii+356. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. net.

The Chemistry of Farm Practice. By S. E. Keitt. Pp. xii+253. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

A Laboratory Manual of Farm Machinery. By F. A. Wirt. Pp. xxii+162. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Microscopical Examination of Steel. By Prof. W. Fay. Pp. iv+18+illustrations. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6s. net.

A Course in Food Analysis. By Dr. A. L. Winton. Pp. ix+252. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7s. net.

Irrigation Works Constructed by the U.S. Government. By A. P. Davis. Pp. xvi+413. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21s. net.

Engineering for Masonry Dams. By W. P. Creager. Pp. xi+237. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11s. 6d. net.

French Forests and Forestry, Tunisia, Algeria, Corsica. With a translation of the Algerian Code of 1903. By S. S. Woolsey, jun. Pp. xv+238. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11s. 6d. net.

Lecture Notes on Light. By J. R. Eccles. Pp. vi+215. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12s. 6d. net.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1918. Edited by G. E. Brown. Pp. 660. (London: H. Greenwood and Co., Ltd.) 1s. 6d. net.

A Laboratory Outline of College Chemistry. By Prof. A. Smith. Pp. v+206. (London: G. Bell and Sons, Ltd.) 3s. net.

Experimental Inorganic Chemistry. By Prof. A. Smith. Sixth edition. Pp. vii+171. (London: G. Bell and Sons, Ltd.) 3s. 6d. net.

Introduction to Inorganic Chemistry. By Prof. A. Smith. Third edition. Pp. xiv+925. (London: G. Bell and Sons, Ltd.) 8s. 6d. net.

Liquid Fuels for Internal Combustion Engines. By H. Moore. Pp. xv+200. (London: Crosby Lockwood and Son.) 12s. 6d. net.

Imperial Institute Monographs on Mineral Resources, with Special Reference to those of the British Empire. Zinc Ores. (London: Imperial Institute.) 2s.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 14.

ROYAL SOCIETY, at 4.30.—The Artificial Production of Echinoderm Larvæ with Two Water-vascular Systems, and also of Larvæ Devoid of a Water-vascular System: Prof. E. W. MacBride.—The Quantitative Differences in the Water-conductivity of the Wood in Trees and Shrubs: Prof. J. B. Farmer.—The Efficiency of Muscular Work: Capt. M. Greenwood.

ROYAL SOCIETY OF ARTS, at 4.30.—The Hide Trade and Tanning Industry of India: Sir Henry Ledgard.

MATHEMATICAL SOCIETY, at 5.—Note on Functional Equations which are Limiting Forms of Integral Equations: Prof. A. C. Dixon.—The Singularities of Trochoidal Curves: Prof. D. M. Y. Sommerville.—A Statement by Fermat: L. J. Mordell.

FRIDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 5.30.—The Mechanism of the Heart: Prof. E. H. Starling.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting.—Traction on Bad Roads or Land: L. A. Legros.—Utility of Motor Tractors for Tillage Purposes: A. Amos.

GEOLOGICAL SOCIETY, at 5.30.—Anniversary Meeting.

SATURDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

MONDAY, FEBRUARY 18.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—A Transformation of the Magnetic Dip Chart: E. A. Reeves.

ROYAL SOCIETY OF ARTS, at 4.30.—The Economic Condition of the United Kingdom before the War: the Real Cost of the War; and Economic Reconstruction: Edgar Crammond.

ARISTOTELIAN SOCIETY, at 8.—Anthropomorphism and Truth: Prof. J. B. Baillie.

VICTORIA INSTITUTE at 4.30.—Sun-spots and some of their Peculiarities: E. W. Maunder.

TUESDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 3.—The Problems of British Anthropology: Prof. A. Keith.

ZOOLOGICAL SOCIETY, at 5.30.—The Development of *Echinocardium cordatum*: Prof. E. W. MacBride.—An African Civet Attacking Human Beings: Capt. G. D. Hale Carpenter.—Reptiles from the River Tajan: L. A. Lantz.

ROYAL STATISTICAL SOCIETY, at 5.15.—Statistics of Poland and Lithuania: G. Drage.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Further Discussion:* The West Quay of Madras Harbour: The Hon. Sir Francis J. E. Spring and H. H. G. Mitchell.—*Probable Paper:* Modern Developments in Gasworks Construction and Practice: A. Meade.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—A New British Oil Industry: E. H. Cunningham Craig, Dr. F. Mollwo Perkin, A. G. V. Perry, and Dr. A. E. Dunstan.

WEDNESDAY, FEBRUARY 20.

ROYAL SOCIETY OF ARTS, at 4.30.—Picturesque Architecture: M. B. Adams.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Photo-synthetic Action Induced in Living Cells, and their Products: Prof. B. Moore.—Illustrations of Preparations: Col. Rawson.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Barometer Record at the Radcliffe Observatory, Oxford, with Special Reference to Prof. Turner's Suggested Discontinuities: F. A. Bellamy.—The Diurnal Variation of Barometric Pressure at Seven British Observatories, 1871–82. A Correction and some Additions: Dr. C. Chree.

THURSDAY, FEBRUARY 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Scattering of Light by Spherical Shells, and by Complete Spheres of Periodic Structure, when the Refractivity is Small: Lord Rayleigh.—The Nature of Heat as Directly Deducible from the Postulate of Carnot: Sir Joseph Larmor.—Curved Beams: J. J. Guest.—(1) Monoclinic Double Selenates of the Iron Group; (2) Selenic Acid and Iron. Reduction of Selenic Acid by Nascent Hydrogen and Hydrogen Sulphide. Preparation of Ferrous Selenate and Double Selenates of Iron Group: Dr. A. E. H. Tutton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Switchgear Standardisation: Dr. C. C. Garrard.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

CHEMICAL SOCIETY, at 8.—Recent Studies on Active Nitrogen: Hon. R. J. Strutt.

LINNEAN SOCIETY, at 5.—Notes on the Bionomics, Embryology, and Anatomy of Certain Hymenoptera Parasitica, with Special Reference to *Microgaster connexus*, Nees: J. Bronté Gatenby.—Experimental Studies in the Specific Value of Morphological Characters in the Fungi: W. B. Brierley.

SATURDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

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THURSDAY, FEBRUARY 21, 1918.

HEAT-DROP TABLES.

(1) *Heat-drop Tables. Absolute Pressures.* Calculated by Herbert Moss from the Formulæ and Steam Tables of Prof. H. L. Callendar. Pp. 63. (London: Edward Arnold, 1917.) Price 5*s.* net.

(2) *Heat-drop Tables. H.P. Gauge Pressures. L.P. Absolute Pressures.* Calculated by Herbert Moss from the Formulæ and Steam Tables of Prof. H. L. Callendar. Pp. 63. (London: Edward Arnold, 1917.) Price 5*s.* net.

(3) *Correction Tables for Thermodynamic Efficiency.* Calculated by C. H. Naylor. Pp. 59. (London: Edward Arnold, 1917.) Price 5*s.* net.

THESE three little manuals are compiled at the instance of the Turbine Section of the British Electrical and Allied Manufacturers' Association for a severely practical purpose. Engineers dealing with designs or specifications for steam turbines will use them in framing estimates of performance, and it is to enable this to be done with the least possible expenditure of thought and time that these tables of heat-drop and certain correcting factors have been put into a handy form for office use. They are founded on the calculations of Prof. H. L. Callendar, who has revolutionised our knowledge of the properties of steam. It is satisfactory to see such clear evidence that British engineers are alive to the practical value of Callendar's scientific work, and ready to avail themselves of it in their business as manufacturers of steam-engines.

For a long time it was known that the data regarding steam, which had come down from Regnault and Rankine, and were quoted in all engineering text-books, were erroneous as well as incomplete. Not only did they fail to meet the new needs that arose when superheating became common, but they also contained grave inconsistencies when tested by means of the general thermodynamic relations that hold among the properties of any fluid. In a paper published in 1900 Callendar showed how a rational table of the properties of steam, complete for all conditions that occur in engineering practice, could be deduced, by the aid of well-established data, from a characteristic equation which he assumed to connect the pressure, temperature, and volume of water vapour in any state. He gave various *a priori* reasons for the type of equation which he selected, and also showed that it had this justification, that the results deduced from it were in close accord with the best results of experiment. Later measurements have only served to confirm this conclusion. More recently Callendar, to the very great advantage of steam engineering, has issued a complete set of steam tables based on his method. The publications now under review accept Callendar's values of the properties of steam as authoritative, and give them certain specific applications, in connection especially with steam-turbine design.

Like many other British initiatives, the new departure which we owe to Callendar found its earliest practical development in Germany. To Prof. Mollier, of Dresden, who is himself the author of valuable contributions to technical thermodynamics, belongs the credit of first recognising the importance of Callendar's work. He turned it to good account in the steam tables and diagram which he published in 1906; and in 1910 the present writer introduced (in the third edition of his book on the steam-engine) the Callendar method and Mollier's application of it to the notice of English students of engineering. Mollier's excellent diagram of total heat and entropy, which enables graphic measurement to take the place of calculation, is now well known.

The "heat-drop" with which these books are concerned is the change that occurs during adiabatic expansion in one of the properties of steam, namely, the function $E+PV$ to which Callendar in 1903 gave the now generally accepted name of "total heat." It is the function which does not change when the fluid is forced through a throttle-valve or porous plug. In adiabatic passage through an engine, on the other hand, the total heat changes by an amount which directly measures the work done. Consequently the heat-drop between admission and exhaust is a measure of the utmost amount of work that can be obtained from steam in passing through a turbine or any other form of engine. Hence its great importance in the design of such engines. For reasons that we cannot go into here the same function in other fluids is equally important in connection with practical problems of refrigeration.

It may seem a far cry from the philosophical abstractions of Willard Gibbs to the everyday requirements of the engineer. The genius of Gibbs laid foundations for much subsequent building, which has been sure, if slow. In this matter we have another proof that science, as the handmaid of industry, fulfils herself in unexpected ways. For the total heat, the "drop" of which is here so fully and exactly tabulated, is nothing else than one of the three thermodynamic "potentials" which Gibbs described in his paper of 1875, using the symbols ψ, χ, and ζ. Of these three functions, ψ and ζ have been applied in the thermodynamics of chemistry, and χ—a stone for which the chemists had apparently no use—has indeed become a corner-stone in the temple of the engineer, who, it may be added, has lately adopted ψ also, but with its sign reversed.

The tables have evidently been prepared with much care. One cannot but regret that the compilers have taken the very retrograde step of using the Fahrenheit scale of temperature. English engineers were beginning to free themselves from this vexatious burden. It is a severe and wholly unnecessary handicap to national progress in engineering.

J. A. EWING.

THE ETHNOLOGICAL VALUE OF SHELLS.

Shells as Evidence of the Migrations of Early Culture. By J. Wilfrid Jackson. Pp. xxviii + 216. (Manchester: At the University Press; London: Longmans, Green, and Co., 1917.) Price 6*s.* net.

THOSE who are interested in recent developments in ethnological studies are aware that a very active school has arisen within the last two or three years in Manchester under the influence of Prof. G. Elliot Smith, who in 1911 directed attention to the widespread influence of Ancient Egypt in his little book, "The Ancient Egyptians and their Influence upon the Civilisation of Europe." Since that date he has made investigations over a wider sphere, and formulated the theory that a large number of apparently associated customs and objects mark the progress of a complex culture throughout a considerable portion of the earth's surface.

Working on these lines, Mr. J. Wilfrid Jackson, the conchologist and assistant-keeper of the Manchester Museum, has published a series of five papers dealing with the geographical distribution of certain shells employed by man and their cultural significance, four of which he has reprinted with new plates and additional information. These are: "The Geographical Distribution of the Shell-Purple Industry," "Shell-Trumpets and their Distribution," "The Geographical Distribution of the Use of Pearls and Pearl-shell," and "The Use of Cowry-shells for the Purposes of Currency, Amulets, and Charms."

Mr. Jackson has amassed a large number of most interesting and suggestive data in a field that, with the exception of shells used in currency, has been very little studied by ethnologists; from this point of view alone Mr. Jackson has done good service. The employment of the pigment found in certain marine shells for dyeing fabrics was known in the Mediterranean area and West Britain, was practised in prehistoric Japan and still is in China, and also by pre-Columbian Incas, and in Central America, where its use has not yet died out. The distribution is thus discontinuous. Three alternatives suggest themselves: (1) That the industry arose independently in these three areas; (2) that it occurred in the intermediate areas and has since disappeared without leaving any trace; or (3) that it was carried by streams of migration, the carriers of which did not necessarily introduce it wherever they went. This technique implies that the individuals adept in the process actually visited South and Central America: objects (or copies of them) may be carried by a cultural drift alone, but not a special technique, as this implies personal knowledge, which must either be conveyed by individuals directly, or, if transmitted indirectly, it must have been employed during the progress of its migration, and of this there is at present no evidence, so far as the purple dye is concerned.

The same argument applies to the association of the moon-god cult and the shell-trumpet in India and Mexico, and many other associations. The cumulative evidence of ethno-conchology is too great to be ignored, and affords additional demonstration of the spread of a complex culture from the culture centres of the Old World to South and Central America.

A. C. HADDON.

MARINE BIOLOGY AND FISH CULTURE.

(1) *Biologia Marina. Forme e Fenomeni della Vita nel Mare.* By Raffaele Issel. Pp. xx + 607. (Milano: Ulrico Hoepli, 1918.) Price 10.50 lire.

(2) *Piscicoltura Pratica. Legislazione sulla Pesca d'Acqua Dolce.* By Prof. Felice Supino. Pp. viii + 327. (Milan: Ulrico Hoepli, 1917.) Price 5.50 lire.

(1) THIS manual follows the lines of the course of lectures on marine biology delivered by the author in the University of Genoa to first-year students, and the subject is treated in a manner suitable to their stage of training. The account deals so far as possible with local conditions and with marine organisms as they may be seen by the observant student on the Ligurian Riviera, and especially in the neighbourhood of the small marine laboratory established in 1912 at Quarto dei Mille (some three miles east of Genoa), of which the author is director. After giving an account of the more important features of aquatic animals in general, and of the physical conditions under which marine animals live, the author sketches the general characteristics and biology of the animals of the plankton, and describes briefly a number of selected vertebrate and invertebrate examples. In the following chapters abyssal forms and the littoral fauna are considered, and in the account of the latter the author has included interesting observations on the behaviour of the flagellate protozoa *Carteria subcordiformis* and Cryptomonas sp. and of the copepod *Harpacticus fulvus* in shore-pools under evaporation. By the time the water in the pools has become strongly saline (density about 1·125), these animals have come to rest and show no sign of life. They have entered upon a "latent" condition, and may survive in that state for two or three weeks, recovering on the salinity of the water being reduced again to the normal.

The animals of the various littoral zones and those found among the algæ, especially the fauna of the extensive Posidonia meadows of that region, are treated in a clear and interesting manner, and there is a well-written chapter on the coloration of marine animals. Two chapters deal with fish and fisheries, and a final chapter is devoted to an account of the apparatus and methods used in collecting and studying marine animals. The author has given a stimulating account of marine organisms and their environment, and by means of the well-chosen bibliography at the end of each chapter—an excellent feature of the manual—has directed the serious student to the more important recent literature on the subjects considered. There are 211 illustrations in the text, many of them original.

(2) The volume by Prof. Supino, director of the hydrobiological station of Milan, forms a useful practical guide to the culture of fresh-water fishes, those specially considered being several species of trout, Coregonus, carp, tench, and eel. Details are given of the process of artificial fecundation, of methods and apparatus employed for rearing the young fish and for packing and transporting eggs, young, and adults, and of the raising of trout in ponds. Copies are given, extending to 117 pages, of the laws and regulations relating to fresh-water fish in Italy and in the lakes bounded in part also by Switzerland and by Austria. There are seventy-nine text-figures and fourteen plates.

OUR BOOKSHELF.

British Rainfall, 1916. *On the Distribution of Rain in Space and Time over the British Isles during the Year* 1916. By Dr. H. R. Mill and C. Salter. The Fifty-sixth Annual Volume. Pp. 256. (London: Edward Stanford, Ltd., 1917.) Price 10*s*.

"BRITISH Rainfall for 1916" contains, despite many trying circumstances, the essential features which make this annual so useful. Mr. L. C. W. Bonacina describes the snowstorms of spring, 1916: on the Black Mountains of Brecon snow lay 5 ft. deep. Mr. Carle Salter discusses the differences in rainfall records due to the use of Halliwell and hyetograph gauges; in connection with "The Measurement of Rainfall Duration" he decides in favour of the hyetograph.

The number of rain-days in 1916 was above the average; both absolute and partial droughts were less frequent than the average, but the absolute droughts lasted longer than usual. At Dungeon Ghyll 0·97 in. of rain fell daily on the average during seventeen days in October. At Camden Square the 1916 rainfall was 34 in., an excess of 39 per cent. on the average, while the number of rainy hours was 628, 44 per cent. above the average; at Cray Reservoir, Brecon, 72 in. fell in 1396 hours. At Kendal an inch of rain fell in 32 min. on July 21.

July 7 was perhaps the wettest day ever recorded for the east of Scotland; 29 sq. miles received more than 4 in. of rain; illustrative maps indicate that the rain fell on the left-hand front of a cyclonic depression which advanced from South Wales to Hull on that day.

On August 29, 622 sq. miles in the south of England received on the average 3·23 in. of rain on the left-hand front of a depression coming up-Channel. February was a relatively wet month in England and Wales. In March the normal distribution of rainfall was completely inverted. A widespread drought terminated on August 12. September was relatively the driest month of the year, while October outdid its reputation as the wettest month of the year, most of Ireland receiving double the normal rainfall.

Les Universités et la Vie scientifique aux Etats-Unis. By Prof. Maurice Caullery. Pp. xii+302. (Paris: Librairie Armand Colin, 1917.) Price 3.50 francs.

PROF. CAULLERY, professor of organic evolution in the University of Paris, was exchange-professor at Harvard University in 1916, and during his five months' stay in the United States he made a study of the American university system, especially from the scientific point of view. In his description of the rise, development, and administration of the various universities in the States, and his illuminating account of the extensive facilities offered for scientific research on the other side of the Atlantic, Prof. Caullery seeks, at every opportunity, to point out the lessons which France might usefully learn from American experience. He emphasises the success with which the universities in the United States have produced not only scholars, jurists, and physicians, but also engineers, agriculturists, and financiers—leaders, in fact, in every department of human activity. He urges the desirability of encouraging in France the intimate connection between university activity and contemporary life which he found existing in America.

The volume appeals almost equally to our own people, and responsible authorities should acquaint themselves with Prof. Caullery's message

The Cause, Prevention, and Treatment of Cancer and other Diseases. By Lt.-Col. W. H. Hildebrand. Pp. viii+163. (London: Cole and Co., 1917.)

THE author offers in this book of fewer than 200 pages a complete explanation of the cause, cure, and prevention of cancer and of "rheumatism, sciatica, lumbago, uric acid, neuritis, varicose veins, arthritis, gout, eczema, pruritus vulvæ, and lunacy." Another short chapter disposes of "adenoids, infantile diarrhœa, tropical dysentery, and hay fever."

"Cancer is a cell-growth actually caused directly by radium or other radio-active mineral substance." "Drinking-water, especially hard water, is the medium through which the radium or other radio-active minerals . . . are generally conveyed into our bodies." The lime and other minerals harden the linings of the various organs, and the radium becomes entangled in this excessive fibrous tissue. Once safely ensconced in the fibrous tissue, it sets up cancerous growth by its continuous bombardment of the surrounding structures. An unsuspected source of radium for this nefarious work is, according to the author, "by *so-called transmutation of lead into radium* in old water-pipes." This is held to account for cancer-houses.

Suggestions for legislation or inquiry by a Royal Commission are plentifully scattered throughout the book, which contains much curious information, of no scientific value.

PATENTS AND SCIENTIFIC RESEARCH.[1]

To encourage scientific investigation and to utilise the results of that investigation for the benefit of the community are problems of the deepest concern. As such they are to-day receiving the attention of the keenest of intellects, and herein lies the hope that from the turmoil of the Great War, with the suffering it has brought in its train, there may emerge a measure of good. Should the present hostilities bring home to the mass of the population a knowledge that with the future of the country is intimately associated the ability to prosecute scientific investigation with diligence, the mighty struggle in which we are engaged will not have been fought in vain.

To bring the abstract reasoner and the research student into closer touch with the needs of the moment, and to direct their energies into channels which shall be productive of the greatest benefit, is no novel endeavour, for in the past they have been the occasion of much deliberation and the practice of many expedients. Of the numerous schemes having these objects in view, some have proved capable of general application, while others have reflected the special purposes which have called them forth, or the work of the institutions immediately interested. No scheme, however, which has been suggested by a reputable body can be said to have been wholly devoid of merit, or to have been incapable of occasional employment. But whether one scheme or the other is preferable in the circumstances of a special case still remains a matter of opinion, and one upon which divergent opinions may rightly be held.

In scientific investigation, the following up of an idea to its logical conclusion, or until definite results are reached, demands unremitting and often exclusive attention, an attention not to be interrupted by considerations foreign to the business in hand. The aloofness thus necessarily engendered is reflected in the proverbial inability of the devotee to protect himself commercially or to secure adequate pecuniary return for prolonged industry. For the encouragement of research and the freeing of the investigator from the petty tyranny occasioned by the needs of daily living, Prof. T. Brailsford Robertson, professor of biochemistry and pharmacology in the University of California, propounds a scheme which, while leaving the investigator untrammelled, also relieves him of much anxiety as regards his physical welfare. In setting out the scheme Prof. Robertson refers to various projects which have been put in hand for stimulating research and for bringing the student into closer touch with the utilitarian or business side of his operations. Thus there are reviewed the action of the Solvay Institute in Brussels, which has set aside certain proceeds from inventions for the support of scientific enterprise, and the procedure of Behring and Pavlov, who have handed over profits obtained by the sale of articles manufactured in the laboratory. The precedent established by Ehrlich in his disposal of the proceeds of salvarsan forms, in addition, an illustrious example whereby the furtherance of research in a special direction may be assisted. In this instance, however, although it was so highly successful, Prof. Robertson alludes to defects difficult to remove. Notably, the intimate association of an individual investigator with a business enterprise, and the absence of supervisory control of the exploitation of a discovery, were felt to be susceptible of improvement. As regards industrial fellowships, which to so many seem to have justified themselves, they have perhaps served to bridge the gap existing between pure science and industrial progress rather than to initiate new developments.

A plan of wider scope and capable of indefinite multiplication occurred to Prof. Robertson. The scheme is essentially based upon payment by results, the results, however, being in part due to co-ordinate action by the governing body of a university. Prof. Robertson suggests the establishment of a trust for the working of such patents as have been obtained by the investigator. After recouping itself for the expenses of this working, the governing body is to hand over a certain sum of money, and, out of profits, to grant an annuity continuable after death in favour of the investigator's dependents. Unexpended profits are to be pooled in favour of the prosecution of research work in definite directions. A board of directors under the governing body is to be deputed to supervise, if desired, the work of research. The scheme is capable of wide application, similar arrangements for specific purposes being susceptible of multiplication. Moreover, Prof. Robertson and his governing body have shown their faith in the project by entering into an agreement on the subject of the growth-influencing substance "Tethelin," which Prof. Robertson had isolated from the anterior lobe of the pituitary body.

Whether it is desirable for an educational authority to depart from its normal functions and to enter into the bustle and competition inseparable from commercial undertakings is questionable. That it would be satisfactory to the patentee, engrossed in his scientific investigation, admits of little doubt; but hesitancy may well be evinced in assenting to the employment of an academic board in the exploitation of patents. Moreover, although the terms of the incorporation of the University of California would seemingly permit of the University entering into business undertakings, many institutions elsewhere have no such privilege conferred by their charters.

Among the many other proposals for stimulating investigators to further effort is the conferring of rewards in the form of money. This method is of considerable standing and has met with success. But in the opinion of not a few a system is still to be found which is less open to criticism and more uniform in application.

[1] "The Utilisation of Patents for the Promotion of Research." By Prof. T. Brailsford Robertson, University of California. Pp. 14. (Privately circulated.)
"A Scheme for the Promotion of Scientific Research." By Walter B. Priest. Third edition. Pp. 88. (London: Stevens and Sons, Ltd., 1910.)
"Observations: an Appendix to the 'Scheme.'" By Walter B. Priest. Pp. 9. (Privately circulated, 1916.)

Mr. Walter B. Priest would regularise procedure and render its operation more certain by assimilating application for State aid to that which obtains when a patent is solicited of the Crown. Mr. Priest has accordingly drafted a Bill, a notice of which appeared in NATURE for January 21, 1909 (vol. lxxix., p. 345). He has since followed up the matter by addressing a series of "Observations" to the Committee of the Privy Council for Scientific and Industrial Research, together with a copy of the Bill and the remarks which accompanied the publication in 1910 of the third edition of the Bill.

The provisions of Mr. Priest's Bill follow closely the Patents Act, 1907, an Act which, while prescribing the method of applying for a patent, modified the substantive law in certain particulars.

According to the plan set out in the Bill and in the "Observations," pecuniary grants

> may be restricted to scientific discoveries and improvements in means and appliances not of a patentable nature which, after investigation in accordance with the provisions of the scheme, are found to have effected or contributed to the attainment of purposes of general utility and advantage subsequently to the applications for such grants.

If, however, it should appear that the subject in respect of which an application for a grant was made was of a patentable nature, the applicant was not thereby to be prejudiced, except in so far as he might be called upon to refund what had already been granted, on the assumption that the discovery was not of a patentable nature.

The proposed Bill speaks freely of "discoveries" in respect of which benefits are to be received, as though the full significance of the word was readily perceptible. But what a discovery may be, or a discovery as opposed to an invention, and where the one ends and the other begins, are scarcely even adumbrated.

In patent law a difficulty similar in kind to this is presented when the attempt, usually futile, is made to distinguish between inventions which are said to be based on a "principle" and those which do not embody a "principle." Usually those who talk most of "principles" in this connection confuse the idea of a principle with an object to be achieved, a problem to be solved, or an end to be attained; and a century and more of litigation has failed to elicit a simple and, at the same time, indisputable account of what is understood when this distinction is brought forward. Indeed, the complete meaning of the word "principle," not only in patent law, but also in many another situation, requires much exposition. So with the word "discovery," which looms so largely in the proposed Bill, for difficulties not unlike these would undoubtedly be encountered in the endeavour to distinguish a discovery, in respect of which a grant is to be given, from an invention, for which the reward is a patent.

Seemingly, however, the question as between a discovery and an invention is to be relegated to a body of examiners or advisers, to whom also the settlement of other points is to be entrusted. In some instances the Judicial Committee of the Privy Council is to be called in aid, or, since the establishment of the Advisory Committee of the Privy Council for Scientific and Industrial Research, this committee may be substituted for the Judicial Committee.

A further notable omission in the scheme presented by the Bill is the absence of relief to the individual, who, having found out some profound "law of Nature," at once ingenuously announces it to the society of which he may be a distinguished member. By so doing he often prepares the way for another, who, not having been mentally congested with the work which led up to the discovery, seizes upon its practical application and for his own advantage embodies it in an invention and forthwith applies for a patent. The originator of the idea, in these circumstances, is at the mercy of the subsequent exploiter. Even if this questionable action has not taken place, the originator may by his announcement have precluded himself from embodying his discovery in an invention for which a valid patent could be obtained, since for a valid patent no previous publication is, in general, permissible.

But no useful purpose would be served by discussing the various clauses of the Bill, for although it might be highly desirable to regularise procedure for obtaining grants in aid of scientific research, yet to model a scheme upon that adopted for obtaining a patent seems to be inadvisable. As the Patents Act stands at the present day, it is incomprehensible without interpretation, while its meaning is usually not what it expresses, as judged by meanings ordinarily attaching to words. In what to the uninitiated is clear and permitting of no dispute, a wealth of judicial exposition is unfolded, whereby curious and recondite meanings are found to be hidden in passages apparently clear and simple. Indeed, the Patents Act is the result of historical accident and must be interpreted by reference to history. To apply its provisions to procedure for obtaining a money grant would be at the outset to tie the hands effectually and to obscure the vision of those to whom the examination of applications and the allocation of moneys were entrusted. Far simpler methods—methods more in touch also with modern requirements—could readily be devised. Even at the present moment a system is in operation whereby inchoate inventions, whether based upon new or old discoveries, receive the help of Government and are brought to fruition, to the mutual advantage of inventor and State. But whatever opinions may be held upon schemes hitherto propounded for the stimulation of scientific discovery and for the rewarding of investigation, it is clear that a collation of all known and workable schemes should be undertaken and a serious consideration of them as a whole put in hand. Whether assistance be given by way of pecuniary grant for definite research or through the medium of industrial scholarships, or whether reward be proportioned to results already achieved—results consisting in discoveries or the application of scientific truths

to manufactures—or whether the individual be left to the operation of patent law, it is difficult to conceive of an inquiry of more urgency or importance than one which would enter fully into the merits of the various systems which have not only been found successful in practice, but have also failed to pass the preliminary stage of suggestion. A report from a competent authority would be of the greatest benefit and would repay many times the expense and trouble involved in its preparation. The Committee of the Privy Council for Scientific and Industrial Research has the means within its power, and it is earnestly to be hoped that it may see fit to advise men of science, academic bodies, and commercial syndicates as to the best procedure for the encouragement of scientific investigation and the application of results to daily needs.

PRECIOUS STONES AND PLATINUM IN 1916.

TO the twenty-fifth volume of "The Mineral Industry," which deals with the conditions obtaining in the year 1916, Dr. G. F. Kunz, the well-known gem expert, contributes not only, as for many years past, the chapter on precious stones, but also another on that most precious of metals, platinum.[1] In passing we may remark that the scope of this annual publication is not so wide as its title would indicate, the subject being considered entirely from the point of view of the United States.

There is no better or surer indicator of the state of the trade of a country than the business done in jewels. It is not, therefore, surprising to learn that the imports of precious stones into the United States during the year under review reached the remarkable total of ten million pounds sterling, this amount being nearly double that of the preceding year, and exceeding by more than one-tenth the figures for what was at the time considered the exceptionally prosperous year 1913. About two-thirds of the chapter on precious stones is taken up with the precious stone *par excellence*—the diamond. During the year the diamond trade with the United States was very much interfered with by the operations of German submarines, more, however, on account of the considerable rise in the rates of insurance than because of the actual losses suffered. At the beginning of the year the Diamond Syndicate raised the price of rough stones by another 5 per cent. This powerful organisation has secured complete control of the diamond market by acting as agents for the sale of the produce of the Premier mine, and by arranging with the Government of the Union of South Africa to purchase the stones found on the sands of the shore of what was once known as German South-west Africa. We are reminded that diamonds, besides their ornamental use, play an important part in industry, and especially the manufacture of munitions of war, by the fact that in November, 1916—none too soon—the British Government placed diamonds suitable for industrial purposes with emery, corundum, carborundum, and all other abrasive materials, whether natural or artificial, on the list of absolute contraband.

Inasmuch as practically all the diamonds placed on the market pass through London, it may appear strange, except to those acquainted with the formerly rigid restrictions of the powerful diamond-cutters' union, that diamond-cutting should have so long languished in this country. The upheaval caused by the war has brought about a change in this respect. Most of the Belgian cutters fled from Belgium on the fall of Antwerp, and many of them came to England. With their aid a number of factories have been started in London, and particularly in Birmingham. Amsterdam, too, benefited by the ruin of the diamond industry of Antwerp, but owing to the shortage of coal a large number of the small factories there were closed by a committee of the trade, and the business was concentrated in the large establishments.

The improved demand for diamonds brought about a revival of business in the South African fields, and the alluvial deposits were very active; the De Beers Company raised very little blue ground, the stones recovered coming almost entirely from ground already on the floors. A 37-carat stone was found in the recently opened Kameelfontein digging, the stones from which have the peculiar opalescence characteristic of those occurring in the Premier mine. Dr. Kunz points out how little India, once the sole source of diamonds, now contributes to the world's supply. It is thought possible that the deep-seated deposits have never been touched; the problem is attracting some attention, but whether prospecting on a suitable scale would prove commercially profitable is under present conditions more than doubtful.

A few interesting points may be gleaned from the remaining pages of this chapter. A large, though imperfectly formed, trapezohedron of garnet, weighing 4·763 kg. ($10\frac{1}{2}$ lb.), was discovered in the course of grading a property in New York in 1915. Rubies, to judge from the experience of the Burma ruby mines, are slowly recovering from the depression under which they have for some years laboured, a depression largely caused by the success that has attended the artificial manufacture of this stone. The demand for sapphires continues steady. The Queensland output was formerly wholly in German hands, and for some two years after the outbreak of war operations were brought to a standstill; but an opening has now been obtained on the London market. It is interesting to note that recent experiments have shown that the transparency of the Queensland stones is much improved if they are subjected to a high temperature.

The extraordinary rise in the value of platinum is a striking instance of what happens when an

[1] (1) "The Production of Precious Stones for the Year 1916." (2) "Platinum for the Year 1916." (New York: McGraw-Hill Book Company, Inc.; London: Hill Publishing Co., Ltd., 1917.)

enhanced demand is coupled with a restricted supply in an uncontrolled market. Owing to the effects of the war the Russian output, which is normally about 95 per cent. of the world's supply, was reduced to about one-quarter, and at the same time platinum was in greatly increased demand for various purposes arising out of the war, such as the contact-process for producing strong sulphuric acid, aeroplane engines, etc. The result has been that the price of refined platinum in New York rose to more than 20*l.* the troy oz.—*i.e.* five times the value of gold weight for weight. Both the high price and the difficulty of obtaining supplies have led to the introduction of various substitutes, such as "palau," a gold-iridium alloy, which has proved very effective for laboratory use; "rhotanium," a gold-palladium alloy, which is satisfactory for all chemical purposes except for use with hot concentrated nitric acid or as electrolytic anodes, and is even better than platinum as a setting for jewels; and "amaloy," an alloy of nickel, chromium, tungsten, etc., which is highly resistant to acid and atmospheric corrosion, and very serviceable in dental work and for surgical instruments. Tungsten appears to have displaced platinum as the material for the targets of X-ray tubes.

PROF. G. A. LEBOUR.

By the death, on February 7, of Prof. Lebour, the scientific world loses a prominent and interesting figure. Born in 1847 and educated at the Royal School of Mines, he served from 1867 to 1873 on the Geological Survey. He was lecturer in geological surveying at the University of Durham College of Science (later, Armstrong College) in Newcastle from 1873 to 1879, and succeeded Page as professor of geology in that institution. This position he occupied until his death, so that for forty-five years he was connected with the college, and for thirty-nine years occupied the chair of geology. In 1904 he received the Murchison medal of the Geological Society, and in the same year was elected vice-principal of Armstrong College.

The transference of heat through the crust of the earth occupied Lebour's attention early and led to measurements of underground temperature in northern coal-pits, and also, in conjunction with Herschel, to the determination of the thermal conductivities of a great number of rocks. This work, issued in a series of B.A. reports from 1873 to 1881, is well known, and many of the data obtained are accepted as standard.

Lebour's name will always be associated with the geology of Northumberland and Durham. Besides his official maps, he brought out in 1877 an excellent geological map of the county of Northumberland, which is the embodiment of much strenuous, clear-sighted labour. He was joint author with Topley of a widely quoted paper on the Great Whin Sill, which may be said to have definitely established its intrusive character. The stratigraphical relations of the carboniferous rocks form the subject of many papers, in which the divisions of the system and the description and correlation of the important limestones, etc., are set forth with admirable lucidity. The economic aspects of the subject find expression in papers on the Redesdale Ironstones and the coals of the Bernician series, especially those associated with the Little Limestone. The future importance of these coals, which occur in rocks below the coal measures proper, is strongly insisted upon, and the lapse of forty years has but added strength to the views then brought forward. Of many papers relating to the geology of Durham may be noted those dealing with the classification of the salt-measures, the breccia-filled fissures in the magnesian limestone (aptly termed by him breccia-gastes), and the marl slate and yellow sands.

Lebour wrote one book, the "Handbook to the Geology and Natural History of Northumberland and Durham," of which three editions have appeared (1878–1889). It is a very effective monument to his life-work in the two counties, and has the remarkable merit of increasing in value the more it is used.

This brief narration of work accomplished gives, however, no true estimate of Lebour's scientific activity and influence. He was a many-sided man, of wonderful fluency, both in the written and spoken word, and a born teacher. His papers are models of clearness and skilful arrangement of material; they are written in flawless English, and they often display that sense of humour which was one of his notable characteristics. These same qualities were, if possible, accentuated in his lectures. He inspired a great band of workers, who have carried his methods and enthusiasm to the four quarters of the globe, and he was ever ready to help, by his sage advice, those whose steps he had directed towards scientific paths. J. A. S.

DR. JOHN McCRAE.

The death of Lt.-Col. John McCrae at the early age of forty-four is a sad loss to the Canadian Army Medical Corps and to the profession at large. Dr. McCrae belonged to the type of modern physician in whom the study of disease is based on a thorough training in biology. A pupil of Ramsay Wright and of A. B. Macallum at the University of Toronto, he began his academic career as fellow in biology, and afterwards went to McGill as fellow in pathology. Associated with Prof. Adami at the Royal Victoria Hospital, Montreal, he became known as a popular teacher and a keen investigator of problems in clinical medicine. He was the joint author with Dr. Adami of the well-known "Text-book of Pathology." Always keenly interested in military matters, he joined his old battery at the outbreak of the Boer War, and in 1902 gained his majority and was given command. It is to be hoped that the valuable notes and sketches of his South African campaigns may be published. In the present war he served with the Canadian Artillery,

and was in the critical battles north of Ypres. Later he took charge of the medical department of the McGill Hospital, and a few days before his death had been appointed consulting physician to one of the British divisions. He was a keen soldier, with a fine spirit of devotion to duty, and a personality which made him beloved by a wide circle of friends on both sides of the Atlantic.

Among Canadian poets Dr. McCrae had a high place. War poems from his pen have appeared in the *Spectator* and in *Punch*. "Flanders' Fields" has the true ring—and will live:

In Flanders' Fields the poppies blow
Between the crosses, row on row,
That mark our place, and in the sky
The larks still bravely singing fly,
Scarce heard amid the guns below.
We are the dead. Short days ago
We lived, felt dawn, saw sunset glow,
Loved and were loved; and now we lie
In Flanders' Fields.

Take up our quarrel with the foe,
To you from failing hands we throw
The Torch—be yours to hold it high;
If ye break faith with us who die,
We shall not sleep, though poppies grow
In Flanders' Fields.

NOTES.

THE political correspondent of the *Daily Mail* announces that the Government has sanctioned a scheme, which will involve several millions of pounds, to provide capital to develop the dye industries in this country. It has been realised for some time that the provision made in 1915, when British Dyes, Ltd., was established, is altogether inadequate to place the industry in a position comparable with that of the great German syndicate of dye manufacturers. The capital of these firms is more than 50,000,000*l.*, whereas that of British Dyes, Ltd., is only about 2,000,000*l.*, and the whole of our dye manufacturing firms have much less than one-tenth the capital of the German syndicate. It is obvious, therefore, that even if a co-operative scheme is arranged between these separate enterprises, much more will have to be done to increase the total capital available for the industry, build the necessary plant, and secure a sufficient number of research chemists and chemical engineers to enable our dye manufacturers to face the severe competition to which they will be subjected at the end of the war. The industry is of prime importance to our national development, for it is bound up with many other manufactures, directly or indirectly, and its ramifications enter into most arts of peace as well as those of war. We are glad to learn, therefore, that the Government is taking the necessary steps to make our position strong enough to withstand the severe assaults which it will have to bear when commercial competition is not restricted by conditions of war.

WE learn from a message from the Petrograd correspondent of the *Times*, published in the issue of February 20, that the abolition of the Julian calendar and the substitution of the reformed, or Gregorian, calendar has been formally announced by the Government of the People's Councils. "Attempts from the time of Peter the Great to effect this reform have always failed through ecclesiastical opposition, but now that the Orthodox Church has been divorced from the State its opinions and traditions are entirely ignored."

WE regret to see the announcement of the death, on February 16, at sixty-four years of age, of Dr. F. M. Sandwith, C.M.G., Gresham professor of physic, and lecturer at the London School of Tropical Medicine.

THE King has approved the grant of the Polar medal with clasp inscribed "Antarctic, 1914–16" to Sir E. H. Shackleton, Lieut. Frank Wild, Lieut. J. R. Stenhouse, and other members of the *Endurance* and *Aurora* parties of the Imperial Trans-Antarctic Expedition, 1914–16.

AT the annual meeting of the Optical Society held on February 14, the election of officers and council for the year 1918–19 was announced as follows:—*President*, Prof. Cheshire; *Treasurer*, Mr. H. F. Purser; *Librarian*, Mr. J. H. Sutcliffe; *Secretaries*, Mr. Wm. Shackleton and Mr. T. Smith. *Members of Council*, Naval Instructor T. Y. Baker, Mr. P. F. Everitt, Mr. J. W. French, Mr. E. B. Knobel, and Mr. F. C. Watts.

WE learn from *Science* that the U.S. War Department has established a Chemical Service Section and two lieutenant-colonels have been commissioned—Dr. R. F. Bacon, director of the Mellon Institute, Pittsburg, to have charge of the chemical work in France, and Prof. W. H. Walker, of the Massachusetts Institute of Technology, to have charge of the work in the United States.

THE acting-secretary of the Decimal Association sends us the following extract from the *New York Tribune* of January 22:—"Adoption of the metric system of measurements for artillery and machine-guns and maps for the American overseas forces was announced to-day by the War Department. The change was agreed upon at the suggestion of the French Government to avoid confusion in France."

THE President of the Board of Agriculture and Fisheries has appointed a Committee to advise in regard to all electrical questions connected with the carrying out of experiments in electro-culture, and, particularly, with regard to the construction of apparatus suitable for use on an economic scale and to the making of such electrical measurements as may be necessary in connection with the experiments. The members of the Committee are as follows:—Sir John Snell (chairman), Mr. A. B. Bruce, Prof. V. H. Blackman, Dr. C. Chree, Mr. W. R. Cooper, Dr. W. H. Eccles, Mr. J. S. Highfield, Prof. T. Mather, Dr. E. J. Russell, and Mr. C. T. R. Wilson. Mr. B. W. Phillips, of the Board of Agriculture and Fisheries, will act as secretary to the Committee, and all communications should be addressed to him at 4 Whitehall Place, S.W.1.

WE regret to note that the death of Mr. John Farquharson McIntosh is recorded in *Engineering* for February 15. Mr. McIntosh was born in 1848, and was connected with the Scottish railways for fifty-two years, nineteen of which he served as locomotive superintendent of the Caledonian line. Immediately after his appointment he began to design a series of locomotives, beginning with the "Dunalastair" for the Glasgow and Carlisle passenger service. He was invited by the Belgian Government to prepare designs suitable for the international express service on the State railways from Ostend. Mr. McIntosh was a member of the Association of Railway Locomotive Engineers, and was president in 1911, in which year also he was created a member of the Royal Victorian Order.

AT the outbreak of the war the Swiss Federal Government seized all the instruments installed in Swiss wireless stations, so that such stations could no

longer receive the daily time-signals transmitted from the Eiffel Tower. At the urgent request of several establishments, the Swiss Administration of Telegraphs and Telephones decided to arrange for the retransmission of such signals, by telephone, as received from the Paris Observatory. Since August, 1916, therefore, Swiss telephone subscribers have thus been able to receive, by telephone each day, between 10.56 and 11 a.m., the Eiffel Tower signals transmitted to Berne and repeated simultaneously. In a recent communication to the Swiss Geophysical Society (quoted in *La Nature* for February 2), M. Paul Ditisheim, the eminent Swiss horologist, states that this service has worked perfectly, and that the signals transmitted in this manner do not vary more than ±0·087 sec. from the time as transmitted from Paris.

REPLYING to a number of questions raised by the vote for a supplementary sum of 4000*l.* for expenditure in respect of art and science buildings in connection with the Civil Service Supplementary Estimates, Sir A. Mond said, in the House of Commons on Monday, February 18, that the Imperial Institute was partly occupied for the sugar rationing purposes of the Ministry. As to the new Science Museum, it was in course of construction, and incomplete. It had been represented that the work of construction ought to be continued during the war, but he was not in a position to complete the construction of museums in existing circumstances. Considerable expense had been incurred in making the finished part of the building suitable for the work now to be done there. Museums now wholly or partly occupied by Government Departments were the National Gallery, the Tate Gallery, the Wallace Gallery, the Victoria and Albert Museum, and the British Museum, of which a small part had been taken over. The vote was agreed to.

THE Norwich Public Library has received for its extensive local collection a valuable donation from Mr. A. H. Patterson, the well-known Norfolk naturalist. On Tuesday, February 19, the Norwich City Council passed a resolution of thanks to Mr. Patterson for his generous gift of "a large and valuable collection of his writings and sketches, comprising his manuscript notebooks from 1878 to 1916 (including original drawings, printed articles, and letters), a complete set of his published works relating to the natural history of Norfolk, and about a thousand of his political, football, and fishing cartoons of local interest." Mr. Patterson has had the opportunity of making continuous observations for about forty years in a district—the Norfolk estuary (Breydon)—which is particularly attractive to naturalists. It is one of best districts in the country for observation of fishes and birds, including a large number of bird immigrants, some of which are extremely rare visitants to our shores. Great success has attended his unceasing vigilance, and he has been able to make valuable additions to the list of Norfolk fauna, particularly fishes. His notebooks are a mine of valuable information, for in them since 1878 he has recorded day by day his careful observations of the fauna, and has preserved notes of curious and interesting specimens which have been brought to him, pen-and-ink sketches, and coloured drawings of interesting examples, and letters from other naturalists regarding his work.

AT the opening ceremony of the Bose Research Institute at Calcutta, the founder, Sir J. C. Bose, delivered an address, published in the *Pioneer Mail* of December 8 last, in which he pointed out that thirty-two years ago, when he began the teaching of science, it was generally supposed that the Hindu mind, immersed in metaphysical speculation, was unable to undertake scientific inquiries. There were then no well-equipped laboratories, no skilled mechanicians. "Twenty-three years ago some of the most difficult problems connected with electric waves found their solution in my laboratory, and received high appreciation from Lord Kelvin, Lord Rayleigh, and others. The Royal Society honours me by publishing my discoveries and offering an appropriation from a special Parliamentary grant." He added :—"The work already carried out in my laboratory on the response of matter and plant-life has opened out very extended regions of inquiry in physics, physiology, medicine, and psychology; but high success is not to be obtained without corresponding experimental exactitude; hence the instruments and apparatus designed here which stand before you in our entrance hall." The institute is admirably equipped for the special research which its staff intends to undertake. An interesting feature is a small garden of sensitive plants. A large double tracing is being automatically made in two parallel curves, one recording atmospheric changes, while the other summarises the responses of a large tree to these changing conditions for every minute of the twenty-four hours.

SOME exceptionally large stone implements discovered in 1887–88 near the Johnstone River, on the Pacific coast of Queensland, are described in the February issue of *Man* by Mr H. Ling Roth. The materials from which they are made are an altered diabase, argillaceous and micaceous grit, and an arenaceous shale. One implement measures 16·5 cm. by 10·9 cm. by 2·9 cm. Dr. Walter E. Roth, who made some inquiries regarding them, states that at the present day such stone axe-heads are not used—in fact, no stone axes are used. They seem to have been procured from quarries, one about ninety miles from the scene of the discovery. Dr. Roth found, in the neighbourhood of Boulia, an axe-head measuring 9 in. in its greatest diameter—considerably larger than any in the collection now described. These appear to be the largest dressed stones hitherto found in Australia, but the Bankfield Museum possesses a similar implement from Lifu, Loyalty Islands, formed of impure jade. It is not so large as some of the big New Caledonian stones fastened at right angles to a handle by sinnet passed through two holes in the stone.

ACCORDING to an investigation on the "Diet, Nutrition, and Excretion of Asiatic Races in Singapore," undertaken by Prof. J. Argyll Campbell, and published in the Journal of the Straits Branch of the Royal Asiatic Society in 1917, the energy value of the diet of a Chinese, a Tamil, or a Malay medical student was only about 1600 Calories. That of a Brahmin was higher, but, the diet being vegetable, was to a large extent unutilised. To compare with this, we may take the diet of an Anglo-Indian, according to McCay, which was 2800 Calories, and that of a Filipino, which was 2630 Calories. It is suggested that the low-energy value of the Singapore diet may be due to the moist atmosphere, which retards loss of heat by evaporation, so that less food is required. Another contributory cause is the small amount of muscular exercise taken by the Singapore student. Although Europeans in the tropics are not inclined to take much exercise, they cannot keep healthy on a European diet unless they do so. The author found the Singapore students to do as much brain work as his previous European students did.

IN a letter written on Christmas Day, 1917, from Dongonab, *via* Port Sudan, Nubia, Mr. Cyril Crossland reports his having found a species of Ophioglossum growing in a patch of disintegrated coral just below the top of a cliff 136 ft. high on Rawaya penin-

sula on the Red Sea coast, near lat. 21° N. The species in question is doubtless *O. capense*, Schlecht., which has already been recorded by Prantl as having been collected by Schweinfurth in May, 1864, in an adjacent locality—the western side of Macaur Island, lat. 21° N., on coral detritus. This species, unlike the European *O. vulgatum*, Linn., prefers dry situations It was collected by Schimper in Abyssinia in sandy desert. The late Prof. Pearson met with it among Acacia scrub in German South-West Africa, and in deep sand at Kiubis, in Great Namaqualand. In Natal it has been found growing only on very dry sandy knolls near Durban. Mr. Crossland remarks that two showers in November constitute all the rain that had fallen at Dongonab during 1917, and that wholly dry years are common. The desert flora of lat. 21° N. is much less abundant, and individual plants are more stunted, than is the case only a hundred miles further south. Generally the plants that occur are confined to water-courses and drainage lines, but the cliff on which he met with the Ophioglossum bears a few bushes near the top.

We have received the 1916–17 part of the Transactions and Proceedings of the Perthshire Society of Natural Science, the pages of which show a continuance of careful work. Mr. Henry Coates, the curator of the admirable regional museum, deals with some stone cists from the Carse of Gowrie; Mr. Graham Callander has an interesting paper on methods of archæological research; Mr. J. A. Donald discusses to good purpose some of the difficult problems of afforestation; Mr. D. A. Haggart describes, in a racy manner, various faunistic and floristic rambles in Mid-Perth, especially among the hills. One of Mr. Haggart's notes is enthusiastic over the delicious meal which may be made of roast sparrow, and another directs attention to a change of colour exhibited by the beetle, *Carabus catenulatus*, when it is excited. Mr. Barclay, the president of the society, records some interesting botanical rarities, such as *Potamogeton gracilis* (reputed to be a hybrid of *P. alpinus* and *P. heterophyllus*), which differs from all, or almost all, other pond-weed hybrids in being fertile and producing good fruit. It has hitherto been found in Britain in only one station in the Shetland Islands. The Proceedings contain a number of notes of interest, *e.g.* on the activity of a hedgehog in catching bees flying and crawling about in front of a hive, and on the sub-fossil antler of an elk (*Alces machlis*) found near Methven in 1801. It measured 27 in. across from one extreme snag to another, and weighed 8¼ lb. A good photograph is given. The Perthshire Society was founded in 1867, and it deserves to be congratulated on its record of fifty years of activity. It wears well, and is a fine example of what a local Natural History Society should be.

In an article on "Forestry in the Dominion of New Zealand," just published in the *Quarterly Journal of Forestry* (vol. xii., pp. 1–28), Sir W. Schlich gives an account of the present condition of the forests in that country, and critically discusses their future management. A Royal Commission, which submitted a report to the Government in May, 1913, practically recommended that the valuable native forests should be replaced by artificial plantations of exotic trees. Sir W. Schlich considers it injudicious to neglect the natural forests, and urges that a considerable area of these should be declared permanent State reserves, and managed for the sustained production of timber in such a way that the more valuable species would naturally regenerate themselves. It is a melancholy fact that, apart from a few remnants, the Kauri forests have been destroyed. This wonderful tree yields one of the finest coniferous timbers in the world, and surely something might be done to restore the tree beyond the reservation of a few acres for sentimental reasons. It is asserted by the Royal Commission that "the timber trees of New Zealand are of much slower growth than those grown in forestry operations the world over." This opinion is quite unfounded. Mr. D. E. Hutchins, who has lately been in New Zealand, states that Kauri is fit to cut at 100 years old, and is then 2 ft. in diameter, which is a greater rate of growth than that of most European trees. Sir W. Schlich, using the meagre statistics available, holds that the growth of *Podocarpus Totara*, the second most valuable native conifer, is equal to that of silver fir, which produces the largest yield of timber of any tree on the continent of Europe. The article, which is replete with statistical, economic, and geographical information, is illustrated with four maps of New Zealand, showing the distribution of the forests, rainfall, and physical features.

Messrs. R. D. Salisbury and G. N. Knapp, in "The Quaternary Formations of Southern New Jersey" (Final Report of State Geologist, vol. viii., 1917), illustrate by an admirable series of drawings the stages in the history of the coastal plain, the material of which is largely derived from Glacial outwash, and was accumulated under terrestrial conditions. A former diversion of the Hudson River is suggested.

The Geological Survey of Scotland has issued a memoir on "The Economic Geology of the Central Coalfield of Scotland, Area II." (1917), covering the country round Falkirk. A number of vertical sections are conveniently included in a pocket at the end. We notice how the miners' words, "fakes," "blaes," and "ribs," which have also invaded Irish geology from the north, are accepted as technical terms, for the benefit of those who will primarily use the memoir.

The Canadian Department of Mines has issued a recent memoir descriptive of the magnesite deposits of Grenville District, Quebec. Magnesite is a refractory material, extensively used in connection with the manufacture of open-hearth steel, and the British demand has been in the past supplied mainly from Greece, particularly from the island of Eubœa, which furnishes the mineral in a high state of purity, containing about 46 per cent. of magnesia, a little more than 1 per cent. of lime, and less than 1 per cent. of silica. It is of great importance that we should be able to obtain all the materials required for our basal industries from within the British Empire, and hence authoritative information upon these Canadian deposits is very welcome. The Grenville area lies just to the north of the River Ottawa, about midway between the towns of Ottawa and Montreal, and is thus conveniently situated as regards exportation of its mineral production. A considerable number of separate deposits have already been proved to exist; the magnesite is practically everywhere intimately associated with dolomite, so that most of it contains more than 7 per cent. of lime. The quantity of magnesite already proved containing less than 12 per cent. of lime is estimated at close upon 700,000 tons, whilst nearly 500,000 tons of mixed magnesite and dolomite, containing more than 12 per cent. of lime, are also known to exist, and there is evidence that other deposits of magnesite still remain to be discovered. It is important that the attention of ironmasters in this country should be directed to the existence of a new source of supply of this important material.

In the *Philosophical Magazine* for January Dr. J. G. Leathem discusses the motion of a hydrodynamical liquid past a two-dimensional contained solid having a

motion of translation and rotation. The object of the paper is to apply the method of periodic conformal transformation to problems of this class of a more general character than those commonly given in text-books. For this purpose the motion is divided into two portions, viz. a uniform rotation of the solid and liquid and a spinning motion with equal and opposite spin past the solid boundary supposed at rest, the two motions combined making up the required hydrodynamical solution.

In the December issue of *The Central* Mr. R. A. S. Thwaites, of Messrs. Allen and Co., Bedford, gives a valuable summary of the results which have been obtained by a study of the effects of the heat treatment of nickel-chrome and other steels on their mechanical properties. This study has been forced on the British steel manufacturers by the authorities insisting that steels for aeroplane engines should satisfy an impact test which the foreign steels available before the war satisfied without difficulty. By hardening the steel at 830° C., and tempering at 640° C. instead of 250° C., the number of foot-pounds required to break a small notched bar by the Izod test can be raised from 25 to 92. The yield point and ultimate strength of the steel are reduced by this treatment, and Mr. Thwaites gives curves showing how all the principal mechanical properties of the steel are affected by tempering at temperatures between 350° and 600° C. From these curves the proper tempering temperature to ensure steel of given mechanical properties may be found.

DURING the last few years a number of experimenters, including Reinganum, Walmsley and Makower, Miehl, Mayer, Sahni, Kinoshita and Ikeuti, have published excellent photographs showing the tracks of individual α particles from radium which strike the photographic plate at glancing incidence. In a recent paper Kinoshita and Ikeuti (Journ. Coll. Sci., Imper. Univ., Tokio, November 20, 1917) sum up our information on this interesting subject, and show a number of such photographs. Special methods were used to obtain very small radiating nuclei, so that the radial tracks of the expelled α particles show up clearly. The track of an α particle (magnification 500 to 1500) is not continuous, but marked by a number of developed grains from ten to twenty in number, depending on the velocity of the particle. An estimate is given of the diameter of these grains, with a discussion of the general theory of their formation and of the action of α rays on a photographic plate.

A RECENT issue of *Industrial Management* (*The Engineering Magazine*) contains several informative articles by officials connected with departments of the United States Government. The Hon. William C. Redfield, Secretary of the Department of Commerce, gives several striking instances of the waste that goes on continually in industry. According to the Department of Agriculture, 65 per cent. of a tree is wasted in converting it into lumber, and ten million dollars further is wasted annually in drying the lumber so made. Again, vast amounts of scrap wood available for making pulp, alcohol, or vegetable products are burned or allowed to rot. It has only recently been realised that whale meat is a delicacy, and that the intestines of the whale make good leather. In the past the carcasses of seals were invariably thrown away after removing the skin, although the blubber can be used to make oil, the flesh for meat, and the bones for fertiliser. Germany, on the other hand, is pre-eminently an economical country, and many of her industries, such as those associated with dyestuffs and explosives, were built up on so-called waste products. The four chief defects in industry to be overcome are:—(1) Separation of science from industry; (2) industrial waste; (3) lack of industrial and commercial education; and (4) ignorance of manufacturing costs. The Hon. L. F. Post gives a summary of the work of the Department of Labour in connection with the war. Among other feats, it has registered 10,000 ship workers in ten days, placed more than 300,000 men in manufacturing employment last year, and adjusted 323 labour controversies in war industries between January 1 and October 25, 1917. Finally, Mr. H. E. Coffin discusses the general organisation of the business department of the United States Government, and analyses the functions of the somewhat complex boards and committees. The complaint has been made that there is too much subdivision. Mr. Coffin, however, thinks that the confusion is more apparent than real—in short, that the three main groups of the war organisation, dealing respectively with purchasing, industrial policy, and labour, are "shaking down."

Engineering for February 15 reproduces some interesting photographs of damage done to the machinery of German steamers interned in Brazil. These photographs illustrate the thoroughness of German destruction; in one case of two damaged cylinders, at least 8000 holes must have been drilled transversely and vertically through the cylinders. The cylinders illustrated had been broken into hundreds of small pieces, and in order to make new cylinders to suit the set of engines it was necessary to collect as many pieces as possible and to patch them together so that the dimensions could be measured accurately. Most of the broken parts were found carefully stored between decks, evidently in order to be used as scrap metal in Germany in the event of the return of the ships to the Fatherland. The number of German vessels interned in Brazil was approximately forty-five, totalling 235,000 gross tons. In the early part of 1917 the Brazilian Government invited Messrs. Vickers, Ltd., to survey the damage and carry out the steps necessary for repair. It was found that the repairs could be carried out in the naval arsenal of Brazil, and great credit is due to the engineering officers of the Brazilian Navy, not only for executing the work, but also for the expedition with which it was carried out.

MESSRS. A. GALLENKAMP AND CO., LTD., of Sun Street, Finsbury Square, E.C.2, have sent us their circulars describing viscometers and centrifugal machines. In the former list are placed Redwood's and Engler's instruments, with details for use. No technical-school laboratory or any works wherein lubricating oils are largely used should be regarded as completely equipped without one of these standard viscometers, for, although it is possible to determine the viscosity of an oil in the usual physico-chemical way, yet the conversion of "absolute viscosity" to "seconds Redwood" is by no means possible with accuracy in every case, and one must remember that the grading of an oil is largely determined by its Redwood number, and not by its true viscosity. In the same list is described a convenient stop-watch for timing the flow of oil. Pensky-Martin's, Gray's, and the Abel flash-point apparatus are also included in this list. For some time past there has been a demand for convenient and compact laboratory centrifuges. In the circular to hand (No. 193) are described hand patterns from so low a price as two guineas to small power-driven instruments, built to run at 5000 revolutions per minute. A modification, designed for the rapid drying of crystals, and based on the design of the works "whizzer," will doubtless be found of value in many laboratories.

OUR ASTRONOMICAL COLUMN.

RELATIVITY AND GRAVITATION.—A pamphlet has just reached us entitled "La spostamento del perielio di mercurio, e la deviazione dei raggi luminosi, secondo la teoria di Einstein," by Attilio Palatini (from *Nuovo Cimento*, July, 1917; Pisa: Stabilimento Tipografico Toscano). The pamphlet, like the article by Prof. Eddington in NATURE of December 28, 1916 (vol. xcviii., p. 328), aims at making the outlines of Einstein's relativity theory clear to those who have not access to his original works. The points in which the new theory differs from our earlier conceptions of Euclidean space and Newtonian dynamics are clearly brought out. As the title indicates, particular stress is laid upon the manner in which it completely accounts for the excess of 43″ per century in the motion of the perihelion of Mercury's orbit, which had been recognised as a difficulty in the Newtonian theory. It is especially noteworthy that the Einstein theory was laid down quite independently of this result, which is therefore in the nature of an undesigned coincidence. It differs in this respect from some other relativity theories, which have assumed arbitrary values for certain coefficients, in order to satisfy the observed facts. Einstein's result involves no arbitrary constant, but simply depends on the ratio of Mercury's velocity to that of light. The pamphlet employs two different methods of development, each leading to the result that the perihelion advances 0·1″ in one revolution of Mercury.

The other test proposed by Einstein for his theory is that a ray of light from a star just grazing the sun's surface and passing on to the earth would be deflected through an angle of 1·75″. It is shown in the pamphlet how this result is deducible from Einstein's principles, and allusion is made to total solar eclipses as affording opportunities for a practical test. The Astronomer Royal has already urged that advantage be taken of the very favourable total eclipse of May, 1919, for experiments of this kind. Prof. Eddington has pointed out that the doctrine that light has inertia would lead us to expect a deflection of 0·88″ at the sun's limb in any case; so the Einstein test depends on the difference between this value and 1·75″.

THE SYSTEM OF κ PEGASI.—The star κ Pegasi is a visual binary having the unusually short period of 11·35 years, and one of the components, as found by Campbell in 1900, is a spectroscopic binary. An investigation of this interesting triple system has been made by Dr. F. Henroteau, utilising spectrograms previously taken at the Lick Observatory, and numerous others recently obtained by himself (Lick Observatory Bulletin, No. 304). Elements of the orbit of the spectroscopic pair, computed for the epochs 1900, 1912, and 1917, clearly show the changes to be expected from the revolution round the centre of mass of the visual system, and they also indicate a revolution of the line of apsides, probably due to perturbations occurring in the spectroscopic binary orbit under the influence of the third body. Combining the data obtained by telescopic and spectroscopic observations, it is shown that the semi-major axis of the orbit of the spectroscopic binary is 511,100,000 km., while that of the visual pair is 1,826,000,000 km. Since the apparent semi-major axis is 0·29″, it follows that the parallax is 0·025″. The total mass of the spectroscopic pair is 10·33 times, and the mass of the other visual component 4·00 times, that of the sun. There are curious variations in the appearance of the spectrum, which seem to be satisfactorily explained by the superposition of an F class spectrum, oscillating in a period of 5·9715 days, upon a spectrum of possibly the same class oscillating by a smaller amount in a period of 11·35 years.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE AND HORTICULTURE.

Baillière, Tindall, and Cox.—A new edition of Cows, Cowhouses, and Milk, G. Mayall.

ANTHROPOLOGY AND ARCHÆOLOGY.

Macmillan and Co., Ltd.—Folk-Lore in the Old Testament, Sir J. G. Frazer, three vols.

BIOLOGY.

Constable and Co., Ltd.—Coniferous Trees, A. D. Webster, illustrated. *C. H. Kelly.*—Spiders and Beetles, and How to Identify Them, S. N. Sedgwick. *John Murray.*—The Life and Letters of Sir Joseph Dalton Hooker, O.M., G.C.S.I., L. Huxley, based on material collected and arranged by Lady Hooker, two vols., illustrated. *L. Reeve and Co., Ltd.*—Flora of Tropical Africa, edited by Sir D. Prain, vol. vi., section 2, part 2, dealing with the orders Ulmaceæ to Cycadaceæ; vol. ix. (Gramineæ), part 2. *The University Tutorial Press, Ltd.*—Text-Book of Botany, J. M. Lowson, Indian edition, revised by Birbal Sahni.

CHEMISTRY.

G. Allen and Unwin, Ltd.—The Treasures of Coal Tar, Prof. A. Findlay. *Baillière, Tindall, and Cox.*—Plant Products and Chemical Fertilisers, S. H. Collins, and a new edition of Aids to Analysis of Foods and Drugs, C. G. Moor and W. Partridge. *Blackie and Son, Ltd.*—A Complete Course of Volumetric Analysis for Middle and Higher Forms of Schools, William T. Boone. *J. and A. Churchill.*—Applied Analytical Chemistry, edited by Prof. V. Villavecchia, translated by T. H. Pope, vol. ii.; Chemical Combination among Metals, Drs. M. Guia and C. Guia-Lollini, translated by G. W. Robinson. *Constable and Co.*—What Industry Owes to Chemical Science, R. B. Pilcher and F. Butler-Jones, with an introduction by Sir G. Beilby ("The Engineer" Series), and a new edition of Laboratory Guide of Industrial Chemistry, A. Rogers, illustrated. *Crosby Lockwood and Son.*—High Explosives: their History, Manufacture, Properties, and Uses, Lieut. E. de W. S. Colver, illustrated. *Longmans and Co.*—Lecithin and Allied Substances: The Lepins, Dr. H. Maclean (Monographs on Biochemistry). *Macmillan and Co., Ltd.*—Sir William Ramsay, K.C.B., F.R.S.: Memorials of His Life and Work, Sir W. A. Tilden, with portraits; The Manufacture of Intermediate Products for Dyes, Dr. J. C. Cain, illustrated. *Scott, Greenwood, and Son.*—New editions of The Chemistry of Essential Oils, E. J. Parry, two vols., and Iron Corrosion, Anti-Fouling and Anti-Corrosive Paints, L. E. Andes. *The University Tutorial Press, Ltd.*—Senior Practical Chemistry, H. W. Bausor.

ENGINEERING.

Benn Bros., Ltd.—Electrical Measuring Instruments: their Design, Construction, and Application, Dr. C. V. Drysdale and A. C. Jolley; The Handling of Materials: A Manual on the Design, Construction, and Application of Cranes, Conveyors, Hoists, and Elevators (being the second and enlarged edition of "Electric Cranes and Hoists"), H. H. Broughton, two vols., illustrated; The Induction Coil, Prof. E. Taylor Jones; Manual of the Telephone, W. Aitken, two vols.; and a new edition of Electric Mains and Distributing Systems, J. R. Dick and F. Fernie. *Blackie and Son, Ltd.*—Tidal Lands: A Study of Shore Problems, A. E. Carey and Prof. F. W. Oliver, illustrated. *Constable and Co., Ltd.*—The Pro-

duction and Treatment of Vegetable Oils, T. W. Chalmers, illustrated; Locomotive Valves and Valve Gears, J. H. Yoder and G. B. Wharen, illustrated; Physical Laboratory Experiments for Engineering Students, S. Sheldon and E. Hausmann, illustrated; and a new edition of Industrial Electrical Measuring Instruments, K. Edgcumbe, illustrated. *Crosby Lockwood and Son.*—The Aviation Pocket-Book for 1918: A Compendium of Modern Practice and a Collection of Useful Notes, Formulæ, Rules, and Tables relating to Aeronautics, R. B. Matthews, illustrated; The Mechanical Engineer's Pocket-Book for 1918, comprising Tables, Formulæ, Rules, and Data: A Handy Book of Reference for Daily Use in Engineering Practice, by the late D. Kinnear Clark, tenth edition, thoroughly revised and enlarged, by H. H. P. Powles, with a new Electrical Section by Dr. F. T. Chapman; The Engineer's Year-Book for 1918, H. R. Kempe, with collaboration, illustrated; Aviation Engines: their Design, Construction, Operation, and Repair, a book for the Student, Engineer, and all interested in Aviation, by a recognised authority, illustrated; Glossary of Aviation Terms in English-French and French-English, Lieut. V. W. Pagé and Lieut. P. Montariol, illustrated; An Aviation Chart: The Location of Aviation Power Plant Troubles Made Easy. A large wall chart, showing a typical aeroplane power plant in part section, with all important components shown. *Macmillan and Co., Ltd.*—Alternating-current Electrical Engineering, P. Kemp, illustrated. *Sir Isaac Pitman and Sons, Ltd.*—Electric Motors and Control Systems, A. Dover, illustrated; A Small Book on Electric Motors for Continuous and Alternating Currents, W. P. Maycock; Rudiments of Telephony, T. E. Herbert; The Stability and Control of Aeroplanes, A. W. Judge (vol. iii. of the Manuals of Aeronautics); Aeronautical Materials and Methods of Construction, A. W. Judge (vol. iv. of the Manuals of Aeronautics); and new editions of Magneto and Electric Ignition, W. Hibbert, illustrated; Alternating-current Work, W. P. Maycock, illustrated; The Practical Telephone Handbook and Guide, J. Poole, illustrated; The Slide Rule, C. N. Pickworth, illustrated; Gums and Resins, J. Parry, illustrated (Common Commodities and Industries Series); Glass and Glass Manufacture, P. Marson, illustrated. *Scott, Greenwood, and Son.* — The Strength of Ships, J. B. Thomas, illustrated; Elastic Stresses in Structures, translated from the French by E. S. Andrews, illustrated; Machine and Fitting Shop Practice, G. W. Burley, two vols; Modern Steam Boilers, E. Pull; Moving Loads by Influence Lines and Other Methods, E. H. Sprague.

GEOGRAPHY.

Cambridge University Press.—The North Riding of Yorkshire, Capt. W. J. Weston (Cambridge County Geographies).

GEOLOGY.

Cambridge University Press.—Lecture on John Michell, delivered before the Yorkshire Philosophical Society, Sir Archibald Geikie.

MATHEMATICAL AND PHYSICAL SCIENCES.

Cambridge University Press.—The Theory of Electricity, G. H. Livens; Theory of Functions of a Complex Variable, Prof. A. R. Forsyth; Lecture Notes on Light, J. R. Eccles. *C. H. Kelly.*—Stars and How to Identify Them, E. W. Maunder. *Longmans and Co.*—Infinitesimal Calculus, Prof. F. S. Carey, in two sections, Section II.; Differential Equations, Dr. H. Bateman (Longmans' Modern Mathematical Series). *Macmillan and Co., Ltd.*—A Text-Book of Physics for the Use of Students of Science and Engineering, J. Duncan and S. G. Starling, illustrated, in five parts: Dynamics; Heat, Light, and Sound; Magnetism and Electricity; Heat; Light and Sound. *The University Tutorial Press, Ltd.*—Intermediate Text-Book of Magnetism and Electricity, R. W. Hutchinson.

MEDICAL SCIENCE.

Baillière, Tindall, and Cox.—Meat inspection Problems, Dr. W. J. Howarth; Aids to Rational Therapeutics, Dr. R. W. Leftwich; and new editions of Papers on Psycho-Analysis, Dr. E. Jones, and Errors of Accommodation and Refraction of the Eye, Dr. E. Clarke. *A. and C. Black, Ltd.*—A new edition of Radiography and Radio-Therapeutics, Dr. R. Knox. *J. and A. Churchill.*—The History and Present Position of Massage and Medical Gymnastics, Dr. Kleen, translated by Dr. Mina Dobbie; and a new edition of A Manual of Bacteriology, Prof. R. T. Hewlett. *H. K. Lewis and Co., Ltd.*—Regional Surgery, edited by Dr. J. F. Binnie, three vols, vol. i.; The Influence of Sunlight in the Production of Cancer of the Skin, Dr. N. Paul, illustrated; The Action of Muscles and Muscle Rest, Dr. C. Mackenzie, illustrated; Anti-Malarial Work in Macedonia among British Troops, Maj. W. G. Willoughby and Capt. L. Cassidy, illustrated; Gould's Pocket Medical Dictionary; Stitt's Tropical Diseases; Stitt's Practical Bacteriology; and new editions of Dr. H. Lewis Jones's Medical Electricity, revised and edited by Dr. L. W. Bathurst, and Landmarks and Surface Markings of the Human Body, L. B. Rawling. *Longmans and Co.*—X-Ray Atlas of the Skull, Capt. A. A. Russell Green, illustrated; Tube Teeth and Porcelain Rods, Dr. J. Girdwood, illustrated. *Macmillan and Co., Ltd.*—The Life of Sophia Jex-Blake, Dr. Margaret Todd ("Graham Travers"), with portraits; An Enquiry into the Analytical Mechanism of the Internal Ear, Sir T. Wrightson, Bart, with an Appendix on the Anatomy of the Parts Concerned by Prof. A. Keith; Fibroids and Allied Tumours: their Pathology, Clinical Features, and Surgical Treatment, Dr. C. Lockyer, illustrated; Hysterical Disorders of Warfare, Dr. L. R. Yealland; Alcohol and Life: A Manual of Scientific Temperance Teaching for Schools, J. A. Hunter, illustrated. *Masson et Cie (Paris).*—Émotions et Commotions de guerre, Prof. A. Léri; Traitement des Psychonévroses de guerre, G. Roussy, J. Boisseau, and M. d'Œlsnitz; Prothèse fonctionnelle en chirurgie de guerre, Ducroquet; Blessures de la Moelle et de la Queue de cheval; Formes cliniques et anatomiques, Traitement, Prof. G. Roussy and J. Lhermitte; La suspension dans le Traitement des Fractures (Appareils Anglo-Américains), C. Robert et P. Desfosses; and new editions of Traitement opératoire des plaies du Crâne, T. de Martel, and Les Blessures du Cerveau, C. Chatelin.

PHILOSOPHY.

Cambridge University Press.—The Neo-Platonists, T. Whittaker, new edition. *Macmillan and Co., Ltd.*—A Commentary to Kant's Critique of Pure Reason, Prof. N. Kemp Smith; Some Suggestions in Ethics, Dr. B. Bosanquet.

TECHNOLOGY.

Baillière, Tindall, and Cox.—The Alkali Industry, Dr. J. R. Partington. *Benn Bros., Ltd.*—Notes on Design of Electromagnetic Machines, part ii., Design of a Slow-speed Alternating-current Generator ("The Electrician" Monographs). *Constable and Co., Ltd.*—Wool, F. Ormerod, illustrated; Cotton, G. Bigwood, illustrated (Staple Trades and Industries Series).

Crosby Lockwood and Son.—Lockwood's Builder's Price Book for 1918, edited by R. S. Ayling, illustrated. *Scott, Greenwood, and Son.*—A new edition of Grammar of Textile Design, H. Nisbet.

MISCELLANEOUS.

G. Allen and Unwin, Ltd.—Scientific Synthesis, Dr. E. Rignano, translated by W. J. Greenstreet. *Cambridge University Press.*—The Collected Papers of Sir Benjamin Browne, containing, among others, the following contributions:—Education from the Employers' Point of View, Labour Problems, Co-partnership, Insurance, and the Scientific Training of Young Workmen. *Constable and Co., Ltd.*—Man's Redemption of Man, Sir W. Osler, Bart.; Science and Immortality, Sir W. Osler, Bart.; A Way of Life, Sir W. Osler, Bart. *John Murray.*—The Herring: its Effect on the History of Britain, A. M. Samuel, illustrated.

PRIMITIVE CULTS.

MISS M. A. MURRAY contributes to *Folk-Lore* (vol. xxviii., No. 3) a paper on the "Organisations of Witches in Great Britain." The author brings forward certain facts which appear to show a connection between witches and fairies—not the little beings which the fancies of poets have evolved; the fairies of the witch trials are the fairies of Scotch and Irish legend. The ritual of the witches is like the ritual of the fairies: both sacrificed children to their god, whom Christians stigmatised as the devil; both stole unbaptised children for the sacrifice; both sacrificed their god or devil every year, apparently on May Day; both had ritual dances of the same type. "If, as many authorities contend, the fairies are really the aboriginal inhabitants of these islands, there is nothing surprising in their ritual and beliefs being adopted by the invading race. And in that case I am right in my conjecture that the rites of the witches are the remains of the ancient and primitive cult of Great Britain."

Mr. T. J. Westropp, who is doing excellent work in investigating on scientific lines the early remains in Ireland, has republished from the Proceedings of the Royal Irish Academy (vol. xxxiv., Section C, No. 3) a paper entitled "The Ancient Sanctuaries of Knockainey and Clogher, Co. Limerick." Here a cairn commemorates the cult of the goddess Aine, of the god-race of the Tuatha de Danann. She was a water spirit, and has been seen, half-raised out of the water, combing her hair. She was a beautiful and gracious divinity, "the best-natured of women," and is crowned with meadowsweet (Spiræa), to which she gave its perfume. She is a powerful tutelary spirit, protector of the sick, and connected with the moon, her hill being sickle-shaped, and men, before performing the rites at her shrine, used to look for the moon—whether risen or not—lest they should be unable to find their way back. They used to visit her shrine on St. John's Eve, carrying wisps of lighted straw, in order to bring good luck to crops and herds. One day some girls saw her, and she showed them through a ring that her hill was crowded with fairies. Her son, the magic Earl of Desmond, is still seen riding over the ripples of Loch Gur until his horse's golden shoes are worn out. This is a valuable instance of the survival in an attenuated form of the primitive figures of Irish mythology.

The beginnings of religion are discussed in an interesting paper by Dr. E. S. Hartland in the *R.P.A. Annual*, published by the Rationalist Press Association, on religion among the Indian tribes of Guiana, based on the researches of Mr. Walter E. Roth, Protector of Indians in the Pomeroon district, British Guiana. "This attitude towards their external and material environment is reflected in their religion—if we may call it religion, which is merely distrust and dislike of the spirits that are believed to surround them, for the spiritual environment can be less steadily and distinctly contemplated than the material, and therefore is even more the subject of surmise and distrust. The unknown is magnified; the strange, the unusual, the unfamiliar, is regarded with uneasiness, with anxiety, evolving into hostility, with wonder and awe, leading not to inquiry and deliberate scrutiny, but to aversion and terror. Such is the mood, and such are the experiences, to which modern psychology is inclined to trace the beginnings of religion."

SULPHUR IN THE UNITED STATES.

THE Smithsonian Institution issues for publication in the Press interesting descriptive articles upon subjects dealt with in many of the bulletins distributed by it. These articles keep the people of the United States in close touch with the activities of the National Museum and other scientific departments and enable them to appreciate the interest and value of the work being carried on. We print below, in a slightly abridged form, an article upon the subject of Bulletin 102, part 3, of the U.S. National Museum, as it deals with a subject of particular importance at the present time, and refers to the ingenious method by which two sulphur deposits near the Gulf Coast in Louisiana and Texas are worked. The success of the process is such that the Gulf deposits are supplying practically all the crude sulphur in the United States, and its development has shifted the world's largest sulphur industry from Sicily to that country.

Few people realise the extent to which sulphur enters into the manufacture of the materials of every-day life that surround them. Yet it is not primarily because sulphur is necessary to convert the sap of a tropical plant into resilient and versatile rubber or wood-pulp into miles of news-print paper that this substance claims our attention at this time; rather because it is numbered among those substances of prime importance, absolutely essential to the carrying on of war, as entering into the very fabrication of explosives themselves. Hence it is not only a matter of curiosity, but also one of urgent interest, to inquire into the sources of this war mineral.

In this connection the appearance is timely of a publication of the U.S. National Museum under the title "Sulphur: An Example of Industrial Independence." This is by Mr. Joseph E. Pogue, of the Division of Mineral Technology, and presents in a few pages, in a simple and non-technical manner, the striking aspects of one of the most interesting mineral industries in the United States to-day. At the outbreak of the war in 1914 the United States was producing each year about 350,000 tons of sulphur, valued at a little more than 6,000,000 dollars. This quantity not only was sufficient to supply the needs of the country, but also contributed about 100,000 tons to European markets. With the development of war activities, however, the production has increased to meet the growing needs of munition-makers, while the exports have decreased as a result of disturbed trade conditions and the need for building up reserves of this essential material at home.

It is a singular fact that the chief raw materials of explosive manufacture are localised in a remarkable manner, and sulphur is no exception to this rule. In the United States practically the entire supply comes from a number of deposits in Louisiana and Texas, near the Gulf Coast. These deposits are similar in

nature, and consist of a series of beds and lenses of pure sulphur at a depth of several hundred feet from the surface.

The discovery of the occurrence of sulphur of this type was made so far back as 1865, in connection with a well drilled for oil. All attempts at mining the sulphur failed, however, until some fifteen years ago, when a highly ingenious method was devised for winning this substance without recourse to the ordinary costly underground operations usually prosecuted in mining. This process makes use of the fact that sulphur melts at a relatively low temperature. By drilling a well through the overlying rock until the sulphur bed is tapped, and then sinking a series of interpenetrating pipes through which superheated steam is forced, the sulphur is melted and forced to the surface as a hot liquid, where it is piped to large bins, into which it pours and cools. This process, which is known as the Frasch process after its inventor, has been described as one of the triumphs of modern technology, and its successful application to the Gulf Coast deposits has in the past fifteen years transferred the centre of the world's sulphur industry from the island of Sicily to the United States, making the States absolutely independent of the rest of the world in this important particular.

With the development of the world-war, the sulphur deposits of the Gulf regions have, of course, assumed special importance as supplying the sulphur needed in the manufacture of gunpowder and other explosives. But in addition to this, these deposits have quite unexpectedly during the past few months been able to meet and solve a critical resource problem arising out of the submarine campaign. This problem concerned the raw materials of the large and very vital sulphuric acid industry, and arose from the fact that most of the several million tons of sulphuric acid used in the United States was made from sulphur-bearing minerals called pyrites, brought as ballast in quantity from large deposits in Spain. The restricted shipping conditions resulting from recent events as a matter of course seriously affected this source of supply, and since sulphuric acid is a product nearly as fundamental to industry as iron or coal, the situation bade fair to assume critical proportions. But it so happens that crude sulphur can also be used in making sulphuric acid, and accordingly the Gulf sulphur deposits have come forward to tide over the dearth of Spanish pyrites until the domestic supplies of pyrites, which are adequate, but as yet only in part developed, can be brought up to a suitable measure of productiveness.

There are numerous lean deposits of sulphur in many of the Western States, but these as yet have practically no effect upon the output of the country. It is certain, therefore, that without the Gulf deposits and the ingenious method of making them available, the United States would have scarcely been able to meet successfully the war needs of sulphur and sulphuric acid, which goes to show, of course, the pressing necessity for widespread appreciation and understanding of the importance of proper development of the mineral industries of the nation.

SCIENCE AS A VEHICLE OF EDUCATION.[1]

THE tendency of the modern school of political thought is to attribute the majority of the great historical events which have attended the various phases of human development to the operation of unseen underlying economic forces. The recognition of this fundamental truth represents a noteworthy advance towards the completer understanding of the factors underlying and determining the evolution of man and of human institutions, but, admitted that economic forces wholly or very largely determine the political evolution of mankind, the question still remains: To what in turn are we to attribute the incessant fluctuations of the ever-urging economic forces? It is not that one consistent economic pressure, incident everywhere and operating in a definite direction, has continually urged mankind towards some undeviating goal; quite the contrary—the economic pressure upon mankind has been fluctuating, variable both in incidence and in direction, and not always advantageous in its immediate outcome.

Not infrequently attempts have been made to correlate these economic forces with geographical conditions, with the happy or unhappy conjunction, here or there, of river, plain, and sea. But the ever-changing aspects of political geography are not to be interpreted so easily. In relation to the brief life of man, the geographic contour of the earth is well-nigh eternal and immutable. Setting aside, without underrating their possible importance, the very few historical instances of decisive variation in geography and climate, such as the desiccation of Central Asia and the extraordinarily rapid shrinkage of at least one great inland sea, Lake Tchad, it is evident that in the long run, were geographical contour and climate the sole factors underlying and determining the incidence of economic forces, the political geography of the world would ere this have become as static as its physical geography, of which it would be the inevitable and deducible outcome. The ceaseless ferment of international politics, never more turbulent than now, would then remain utterly inexplicable.

To find any analogy corresponding with the bewildering intricacy and rapid fluctuations of political history and geography, we must turn to the inward workings of the human mind, of which economic forces are in ultimate analysis merely the outcome and expression, deviated or constrained, but not created by the geographical, climatic, or biological environment in which they find their outlet. Behind the economic forces which have fashioned human destiny we must seek again the more potent forces of human energy, curiosity, and inventiveness.

It is related that when recently the untutored savages of a certain region of East Africa first saw an aeroplane hovering over their heads they worshipped it as a god, or the expression of a god-like power. A group of high-school or university students would have regarded that same aeroplane with mild curiosity or supercilious indifference, so greatly has education, or what passes for education, blinded our eyes to underlying verities, to truths which are patent to the savage! For, if we regard it aright, every automobile, every passing electric street-car, every ray of light we cast into the darkness with the touch of a finger, is a miracle and a monument to the creative intellect of man.

It is these things and such as these that determine the economic forces which fashion the history of man. The discovery of America was not an accident; it was the outcome of measurement and invention, directed by an inspired curiosity regarding the structure of the universe. The discovery of the steam-engine was not an accident; it was the outcome of countless patient investigations inspired by no thought of ulterior gain. Electricity was not harnessed by financiers, but by the monumental intellectual labours of Oersted, Ampère, and Faraday. These things did not happen by chance; they did not, like Athena, spring full-armed from the brain of Zeus; they did not rain down upon earth from heaven, nor have they always been. They were not fashioned in the market-place, nor yet achieved

[1] By Prof. T. Brailsford Robertson. Reprinted from the *University of California Chronicle*, vol. xix., No. 1.

by sporadic flashes of prophetic inspiration. They are the expressions of the creative intellect of man operating under a certain discipline of thought, inspired by the one undeviating desire to understand, and by understanding to control, the environment in which we have our being.

Essentially the same discipline of thought and essentially analogous expansions of economic opportunity have been operative and determinative forces at all stages of man's development. The foreshortening of our remote past, due to its relatively immense distance from our own lives and the accelerated evolution of our own day, tends to render us forgetful of the obscure struggles and achievements of our ancestors. Yet the peoples from whom we sprang did not lack their Faradays or Pasteurs, upon whose accumulated labours they fashioned new civilisations and rose to greater and ever greater mastery over the inanimate, brute forces to which our yet remoter forbears paid the homage inspired by fear. This is the primary impelling force which fashions the fluctuating yet ever-progressing evolution of man, the force of creative human intellect, perchance inspired, yet inspired not without preparatory labour, for, in the words of Pasteur, "Chance favours only the prepared mind."

If the woof of the fabric of history is economic, the warp is supplied by the creative curiosity of man, operating under the discipline of thought which we now call "scientific," and culminating in discoveries and inventions.

It is strange how little suspicion of these facts enters into the minds of the typical products of modern scientific pedagogy, the vast number of students who in our day patiently submit themselves for years to the exacting discipline of scientific training in order that they may apply it hereafter to the solution of the immediate practical or theoretical problems of their time. The more prolonged and extensive their training, the more intensely specialised their interests become, until the material and spiritual welfare of the vast human family, which alone confers meaning and dignity upon their task, becomes a matter of utter indifference in comparison with the identification of a diatom or the measurement of the angle of a crystal.

There can be little question that as pedagogues and expositors, with a few brilliant exceptions, scientific scholars and investigators have failed, and that in a manner and to a degree most disastrous to the welfare of their chosen field of intellectual endeavour. Notwithstanding several decades of widespread training in scientific method and the scientific discipline of thought, and notwithstanding, also, the multitude of technically skilled and professionally trained men who have issued from our laboratories, there is as yet little or no sympathy or understanding displayed by the public, or even by our own pupils, with the larger problems and broader aspects of science. The reason is not far to seek; deficient sympathy and insight have propagated their like, and we are merely reaping that which we have sown. We have taught our pupils to regard science as an arid, inhuman outgrowth of pure intellectualism, useful perchance, but not endearing, interesting perchance as chess is interesting, but never touching the deeper problems and broader aspirations of mankind save to wither our illusions and proffer the material bait of utility in their stead. Our discipline of thought has taught us to shun hasty generalisation, but we have taught our pupils never to generalise at all, and in teaching them to contemplate and to conquer the difficulties that lie at hand we have deprived them of the exalted vision of the ultimate goals towards which our labours are directed. Thus have we earned, and most richly deserved, the indifference or the veritable hostility of the public, and, crowning absurdity of all, the sciences are everywhere proclaimed antagonistic to the "humanities."

How gross is the caricature of our ideals and our functions which we have implanted in the minds of our contemporaries may be gathered from the words of the great founders of the scientific school of thought. Witness the exalted vision of their labours embodied in the utterances of three great physicists, representatives of three distinct epochs of scientific thought: "I do not know what I may appear to the world," said Newton, "but to myself I seem to have been only like a boy playing on the seashore, and diverting myself now and then in finding a smoother pebble or a prettier shell than ordinary, while the great ocean of truth lay all undiscovered before me." "The laws of Nature," said Oersted, "are the thoughts of God," or, in the words of a master of our own day, J. J. Thomson: "As we conquer peak after peak, we see in front of us regions full of interest and beauty, but we do not see our goal, we do not see the horizon; in the distance tower still higher peaks, which will yield to those who ascend them still wider prospects, and deepen the feeling, the truth of which is emphasised by every advance in science, that 'Great are the works of the Lord.'" Or, in regard to the function of science towards the welfare of humanity, compare the prophetic utterances of Harvey: "We can never want matter for new experiments. We are as yet got little further than to the surface of things: we must be content, in this our infant state of knowledge, while we know in part only, to imitate children, who, for want of better skill and abilities and of more proper materials, amuse themselves with slight buildings. The further advances we make in the knowledge of Nature the more probable and the nearer to truth will our conjectures approach; so that succeeding generations, who shall have the benefit and advantage both of their own observations and those of preceding generations, may then make considerable advances, 'when many shall run to and fro and knowledge shall be increased,'" with the words of Pasteur, written two hundred and fifty years later: "Science is in our age the soul of the prosperity of nations and the living source of all progress. Without doubt the politician with his tedious and perpetual discussions seems to be our guide. Vain illusion! That which leads us is scientific discovery and its applications." And yet the material welfare of man is not the chief justification of science, for, in the words of the same master: "The cultivation of the sciences in their highest expression is perhaps more necessary to the moral welfare of a nation than to its material prosperity."

In these utterances we read, not the cheap hope of material gain or the paltry personal triumph of the clever solver of an intricate intellectual puzzle, but a sense of "something far more deeply interfused," an expression of the awe and abiding wonder which the contemplation of our universe compels, and a deep conviction of the vast underlying import of natural law in the welfare and aspirations of mankind. Why, then, do we so diligently wrap up these aspirations and convictions in formulæ and conceal them under the cloak of a pedantic affectation of hypercritical exactitude? There is a grandeur in science, wide as the universe itself. There is a human import of science, embracing the material and social welfare of the totality of mankind. Would it not, then, be well to convey some suspicion of these facts to our pupils?

We have succeeded after many years of conflict with educational authorities in introducing scientific studies into the curriculum of schools, but what have we accomplished thereby? Through the agency of the compulsory dissection of flowers, the unalleviated algebra of statics, or the uncertain pursuit of the elusive elements of a chemical "unknown," we have given rise to a rooted aversion to science in the minds of many and have attracted a few to the pursuit of science for the sake of material gain, but in how many minds

have we implanted the idea of the intrinsic grandeur or the essential ultimate value of their scientific studies? The spectre of specialism has pursued us. "Science" must be chemistry, physics, geology, botany —anything rather than the study of the dependency of human welfare upon our capacity to control our environment, and the contemplation of the majestic spectacle of the order of Nature gradually unfolding itself to man's consciousness and placing in his hand the implements of ever-augmenting power to control his destinies and attain that ultimate comprehension of the universe which has in all ages constituted the supreme aspiration of man. Had we offered this, had we employed scientific education rather than scientific training as the introductory chapter of the book of scientific knowledge, then all the educated civilised inhabitants of the world to-day would look to science for hope and inspiration, and we should hear no more of the conflict between science and the "humanities," for science would be recognised in its true light, as the first and greatest of the "humanities."

In the universities, even more than in the schools, specialisation has sacrificed education to the exigencies of training. Every opportunity is offered to the student of becoming an expert in the technique and a master of the details of any of the sciences, but on their relationship to the larger needs and aspirations of the world our instructors are silent. This silence arises only too often out of indifference, but where indifference does not prevail then an over-sensitive deference to professional etiquette no less effectually imposes silence upon the professional teacher of science. The desire not to trespass upon the technical field of a colleague and the desire to avoid the criticism of colleagues which may be aroused by the appearance of over-generalisation inhibit in almost every instance any deliberate attempt to open up before the student the deeper foundations and wider implications of the scientific discipline of thought.

As the demands for "vocational training" become more insistent and more complex, this condition becomes more and more aggravated, so that unless measures be deliberately taken to check the prevailing tendencies we may anticipate, alongside the continual improvement of technical training, the progressive deterioration of scientific education, with accompanying decay of scientific philosophy and increasing misunderstanding of the purposes and misapplication of the products of scientific investigation.

Much may be done by the individual teacher; still more might be accomplished by a deliberate campaign of popularisation, by taking the public into our confidence regarding our wider aims and the part played by investigation and discovery in the life and destiny of man. But there is one desirable measure which should be taken by the universities as the official leaders of educational reform, namely, the recognition of the study of the historical development of science in its relationship to human welfare and the evolution of human institutions, as a legitimate department of the many-sided curriculum which the modern universities offer to the student-public. It will be admitted, I think, that scientific investigation, discovery, and invention have played at least as great a part as war, literature, or commerce in the evolution of civilisation, and, that being the case, it is nothing less than astounding that while ample facilities are offered by our universities to the student of the history of war, literature, or commerce, no facilities and no academic recognition whatever are offered to the student of the history of science.

It is perhaps a debatable question whether this end could best be attained by the foundation of a new department and a separate chair or lectureship in the history of science, or whether the situation could preferably be met by the co-ordinated effort of existing departments. However this may be, one thing is certain: that the present atomistic condition of scientific learning in the minds of our students and the restricted utilitarianism of their outlook will not be corrected by offering them a "course in general science," consisting of a *mélange* of ill-assorted fragments of scientific specialities and necessarily failing to furnish either a vehicle of training or a vehicle of education; nor will it be corrected by offering them courses in another specialised course in the history of science in which that history is violently detached from the history of the development of man and of the evolution of his institutions, from the study of the part played by knowledge in determining the reaction of the mind of man to the varying circumstances by which from epoch to epoch he has successively found himself environed; for the new course must above all things be one of the "humanities."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MANCHESTER.—A group of large firms engaged in the principal industries of the Manchester district has offered to the governing body of the School of Technology the sum of 3000*l.*, spread over a period of five years, towards the cost of establishing a new department of industrial management. The Manchester Education Committee has recommended that this gift be accepted and expressed its high appreciation of the donors' public spirit. It is proposed that a lecturer shall be appointed for this period of five years at a salary of 600*l.*, to conduct research in the subject of industrial management, to organise a new department, to lecture to members of the University and to the public, and to assist industrial concerns in the solution of management problems. To make doubly sure that the department shall keep in close touch with practice, a number of managers, directors, scientific experts, and others who have had special experience or are responsible for important innovations, will be invited to deliver public lectures, for which they are being offered substantial fees. These lectures should be of assistance not only to future managers, but also to those already in that position; they will strengthen the idea that management is a science, and that every manager is, or should be, something of a scientific researcher.

SHEFFIELD.—It was something more than a domestic function at which the Marquis of Crewe was installed as Chancellor of the University on Friday, February 15. The ceremony was the first of its kind in Sheffield, as the late Chancellor was born, so to speak, with the University. He was part of the gift of the Crown, whereas Lord Crewe was elected by the Court in the manner prescribed by the charter. The formal act of installation was conceived as taking place at a meeting of the Court in the presence of the University, and the Senior Pro-Chancellor (Mr. H. K. Stephenson), who normally presides over the Court, performed the act of installation. This was a departure from the precedents of Leeds and Manchester, but the Sheffield interpretation of the meaning of the ceremony is probably based on sounder legal grounds. Once in the chair, the new Chancellor took charge of the proceedings with characteristic grace and dignity. Before declaring the Congregation open for the conferment of degrees, he spoke admirably on various burning problems, and his pronouncements should do much to increase the intimacy and friendliness of the relations between the civic and industrial life of the city—close as they already are. It was something to hear the first chairman of the Privy Council Committee on Scientific and Industrial Research say that in his view,

"the closer the tie between the University and the prime industries of the city the better for both." The honorary graduates were introduced to the Chancellor by the Public Orator (Prof. A. H. Leahy) in terms which did full justice to a great occasion, for an assembly which included the Ambassadors of the great Allied Powers, France, the United States, and Italy, was a memorable assertion of the University's faith in the common cause, and the presence there of representatives of sister universities made that assertion more deeply significant. The University also did honour to itself by conferring the degree of Doctor of Letters on the President of the Board of Education, its former Vice-Chancellor.

DR. R. S. WILLOWS, head of the department of physics and mathematics at the Sir John Cass Technical Institute, Aldgate, London, has been appointed head physicist to Messrs. Tootal Broadhurst, Lee, and Co., of Manchester, in connection with their scheme for cotton research.

MR. D. B. MAIR and Mr. L. C. H. Weekes have been appointed Assistant Civil Service Commissioners. The former will also hold the office of Director of Examinations, and the latter that of Secretary to the Civil Service Commission. Mr. Stanley M. Leathes remains the First Commissioner, but Mr. Herbert W. Paul has retired from the post of Second Civil Service Commissioner which he has held since 1909.

THE course of public lectures on "Some Biological Problems of To-day," arranged in co-operation with the Imperial Studies Committee, are being continued at University College (Gower Street, W.C.) on Mondays at 4 p.m. The remaining lectures of the present term will deal with important questions of food production, as follows:—(1) The possibilities of increased crop production, by Dr. E. J. Russell; (2) Grassland and arable, by Mr. R. G. Stapledon; (3) Farm strategy of the past and for the future, by Mr. K. J. J. MacKenzie; (4) Spraying problems, by Dr. A. S. Horne; (5) Birds and insects in relation to crops, by Prof. S. J. Hickson; (6) Co-operation in food supply, by Mr. A. G. Tansley. The lectures are open to the public without fee or ticket.

THE first four lectures of the public university course on "Animal Life and Human Progress" at King's College, London, have been very well attended. Prof. A. Dendy delivered an introductory discourse on "Man's Account with the Lower Animals," Prof. G. C. Bourne has lectured on "Some Educational and Moral Aspects of Zoology," Mr. C. Tate Regan on "Museums and Research," and Prof. J. Arthur Thomson on "Man and the Web of Life." The remaining lectures of the course will be given by Prof. F. Wood Jones on "The Origin of Man" (February 27); Dr. R. T. Leiper, on "Some Inhabitants of Man and their Migrations" (March 6); Prof. R. T. Punnett, on "The Future of the Science of Breeding" (March 13); Prof. W. A. Herdman, on "Our Food from the Sea" (March 20); and Prof. Robert Newstead on "Tsetse-flies and Colonisation" (March 27). It is intended to publish the lectures in book form with Messrs. Constable and Co., Ltd., after the conclusion of the course.

THE annual general meeting of the Association of Technical Institutions will be held on February 22 and 23, at the Drapers' Hall, Throgmorton Street, E.C. The president, Sir Alfred Keogh, G.C.B., will take the chair, and deliver a short address. Papers will be read on the training of teachers for technical institutions and day continuation classes, by Principal Watson of Keighley, and on the Education (No. 2) Bill, 1918, by Prof. Wertheimer, of Bristol. Among the resolutions to be submitted to the meeting may be mentioned those urging, in the interest of technical education, that scales of salary providing for adequate increases and reasonable prospects should be adopted for all fully qualified full-time teachers, and that the Government be requested to make a grant to technical-school teachers, as it has done in the case of primary- and secondary-school teachers; those expressing general approval of the provisions of Education (No. 2) Bill and recording the opinion that an alternative plan should be allowed in Section 10 of the Bill, such plan being half-time compulsory attendance from fourteen to sixteen years of age, together with encouragement of, and ample facilities for, attendance afterwards at evening classes for two evenings per week on technological or other subjects from sixteen to eighteen years of age, and those expressing disappointment that the Board of Education has not yet withdrawn or modified the objectionable features of the Regulations for Junior Technical Schools.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 7.—Sir J. J. Thomson, president, in the chair.—Prof. O. W. **Richardson**: The photo-electric action of X-rays. In this paper the excitation of electron emission by X-rays is discussed in relation to our knowledge of the photo-electric action of other types of radiation. The ratio E_K/E_A of the energy E_K emitted in the form of K secondary X-radiation to the energy E_A of the primary radiation (wave-length λ) absorbed is found in the case of bromine to be expressed to within the degree of accuracy of the available observations by the formula

$$E_K/E_A = \frac{\lambda}{(1+p)\lambda_K}$$

where

$$p = e^{-0.46 \frac{\lambda_{K\gamma}-\lambda}{\lambda}}$$

λ_K is the average wave-length of the K radiations and $\lambda_{K\gamma}$ is the wave-length of the shortest K radiation.—F. **Soddy** and J. A. **Cranston**: The parent of actinium. (1) In a full historical introduction the data obtained in 1909 relative to the rays and products of uranium-X are discussed, in so far as they throw light on the various possible modes of origin of actinium. (2) The minute growth of actinium previously put on record in 1913 as having been observed in the old uranium-X preparations has been confirmed by their later history and is now established beyond doubt. (3) Uranium-X_2 can be separated from uranium-X_1 by sublimation in a current of air charged with vapours of carbon tetrachloride at a temperature below visible red-heat. (4) 470 grams of a very pure Indian pitchblende were similarly treated in the expectation of removing eka-tantalum isotopic with uranium-X_2 and giving actinium in an α-ray change of long period. (5) The preparations so obtained were initially free from actinium, but one of them has produced it continuously with the lapse of time. (6) A direct comparison of the amount of actinium in this preparation after the lapse of 2·5 years with that in the original pitchblende showed that it was equal to that in about 0·25 gram. (7) On the assumptions that eka-tantalum and actinium are both long-lived, that no intermediate members intervene between them, and that the preparation contained the whole of the parent of actinium in the original mineral, the period of average life of actinium is calculated to be 5000 years. Nothing can yet be said definitely as to the period of the parent. (8) A second preparation separated from Joachimsthal pitchblende, the treatment of which commenced in 1903, and ended in 1914, with the carbon tetrachloride

sublimation, has given a similar growth of actinium. (9) The work was undertaken to test and confirm the view that the parent of actinium occupies the eka-tantalum place in the periodic table, and gives actinium in an α-ray change of long period, itself being formed as the product of uranium-Y, discovered by Antonoff, who suggested that it was the first member of the actinium series. But this mode of origin of actinium, though at present the most probable, is not yet conclusively established to the exclusion of all the other possible modes of origin, discussed in the historical introduction.—Prof. A. **Schuster**: Some problems in the theory of radiation. This paper deals with the oscillatory energy taken up by a simple resonator under the action of white light, and the translatory energy imparted to a molecule by radiation. The first problem has been treated by Planck. It is solved here in a very simple manner, and the method used, when applied to the second problem, leads to the important result that a molecule at rest, within an enclosure of uniform temperature, will, while taking up an oscillatory energy, be set in motion with an acceleration that will increase its speed until the average energy reaches a definite value. If the Rayleigh-Jeans laws of radiation be assumed to hold, the ultimate average energy due to radiation alone is two-thirds of that derived from the kinetic theory of gases.—E. A. **Owen**: The absorption of the radiation emitted by a palladium anticathode in rhodium, palladium, and silver. (1) A short account is given of some preliminary experiments carried out with the rays from an ordinary X-ray bulb. (2) A spectrum of the rays from a palladium anticathode is obtained over a limited range of wave-lengths by reflection in the (111) face of a carborundum crystal. The spectrum shows that the bulb emits a continuous band of wave-lengths upon which are superposed the characteristic rays of the metal of the anticathode, and under the conditions of working in this particular case the relative intensities of the different wave-lengths in the spectrum remained approximately constant. (3) The "end radiation" of the bulb was found to be very homogeneous. (4) There is a minimum of intensity in the spectrum corresponding with the wave-length 0.493×10^{-8} cm. On the assumption that the minimum is due to the selective absorption of this wave in the crystal, the value 0.493×10^{-8} cm. is assigned to the β line of the J series of silicon. From the experimental results of Barkla and White on the J series of the elements Al, C, and O, the approximate values deduced for the β line of the J series of oxygen and carbon are 0.519×10^{-8} cm. and 0.559×10^{-8} cm. respectively. (5) Assuming Bragg's mean value of the α line of palladium to be 0.586×10^{-8} cm., the following values are obtained for the wave-lengths of the β and γ lines: $\beta = 0.520 \times 10^{-8}$ cm.; $\gamma = 0.509 \times 10^{-8}$ cm. (6) The absorption coefficients of the rays from the bulb have been measured in rhodium, palladium, and silver. The results show that the relation between wave-length and absorption coefficient is expressed by the relation $\tau/e = K\lambda^3$, where τ/e is the fluorescent coefficient and K is a constant for a given substance over the range of wave-lengths between the absorption bands of that substance. (7) The critical wave-length necessary to excite the characteristic rays of a substance lies in the neighbourhood of the β ray of that substance. The α ray is not excited until the β ray is excited. (8) It is pointed out that the purity of the characteristic lines emitted by a bulb and isolated by reflection at a crystal face will depend, to a great extent, upon the state of working of the bulb.

Zoological Society, February 5.—Dr. A. Smith Woodward, vice-president, in the chair.—Prof. B. L. **Bhatia** and Baini **Prashad**: Skull of *Rana tigrina*, Daud.—G. A. **Boulenger**: Description of a new snake of the genus Oligodon, from Upper Burma.—Dr. R. **Broom**: Two rare South African golden moles. One specimen was described as a new species of Bematiscus, *B. leschae*. Hitherto the giant moles of the eastern Cape Colony have been referred to *B. trevelyani*, but the present type from St. Cuthbert's, Isolo, differs from *B. trevelyani* and agrees with *B. transvaalensis* and *B. villosa* in having the temporal bulla markedly projecting from the side of the skull. The other specimen exhibited was one of the rare mole, *Chrysochloris sclateri*. Hitherto it has been only known from the Nieuwveld and from Basutoland—localities 350 miles apart. The present specimen was from New Bethesda, 130 miles nearer to Basutoland than the original locality.

Mathematical Society, February 14.—Prof. H. Hilton, vice-president, in the chair.—Prof. A. C. **Dixon**: Note on functional equations which are limiting forms of integral equations.—Prof. D. M. Y. **Sommerville**: The singularities of trochoidal curves.—O. **Hoppe**: The primality of $(10^{19}-1)$ (second communication).—L. J. **Mordell**: A statement by Fermat.

EDINBURGH.

Royal Society, January 14.—Dr. John Horne, president, in the chair.—Prof. R. A. **Sampson**: Notes on the Coupar Angus meteorite. This meteorite, which attracted much attention from its brilliancy before it burst, fell on December 3, 1917, and fragments were found in Perthshire and Forfarshire. It is an aerolite or stony meteorite, but the detailed mineralogical characters have not yet been given. It was estimated, from the evidence of a number of witnesses, that it began to blaze at a height of about twenty miles in the atmosphere, probably above Coupar Angus. In regard to the origin of such bodies, it was suggested that they might have been ejected in bygone ages from lunar volcanoes, continuing to circulate since then between the earth and the moon in irregular orbits until finally drawn down upon the earth.—Dr. C. G. **Knott**: The propagation of earthquake waves through the earth and connected problems. When a large earthquake occurs at any part of the earth elastic waves are sent out in all directions through the earth, emerging at the surface as disturbances which can be recorded on delicate seismometers. Up to about 120° from the epicentre, the times at which these variations emerge after the time of occurrence of the earthquake were first tabulated by J. Milne. The increasing number of observations and the improvement of the instruments have led to the tabulation of more accurate data than was possible in the earlier days. Following up certain calculations made in 1908, Dr. Knott, using these more recent data, has made fresh calculations of the velocities of the seismic waves through the earth by a mathematical method based on the theory of integral equations and entirely free from assumptions. As has long been recognised, two types of wave are transmitted through the body of the earth known as the primary (P) and the secondary (S) waves. The broad results of the investigation may be stated thus:—The velocity of the P wave increases steadily with depth from 4.46 miles (7.18 kilometres) per second at the surface to 6.2 miles (10 km.) per second at a depth of 400 miles (650 km.), continuously increasing at a slightly smaller rate of increase until it reaches 7.95 miles (12.8 km.) per second at a depth of 1000 miles (1600 km.), after which, at greater depths, the speed of propagation remains constant. The S wave travels more slowly than the P wave, but changes in very much the same way, the values of the speed being 2.47 miles (3.98 km.) per second at the surface,

3·43 miles (5·53 km.) at a depth of 400 miles, and 4·25 miles (6·84 km.) at depths greater than 1000 miles.—Prof. W. H. **Metzler**: A determinantal equation the roots of which are the products of the roots of given equations.—Prof. R. A. **Sampson**: Studies in clocks and timekeeping. (1) The theory of maintenance. This paper, the first of a series of studies which are in course of execution at the Royal Observatory, Edinburgh, describes in outline the arrangements of the thermostat chamber, etc., and the construction of the three clocks, Riefler 258, Synchronome, and Cottingham, upon which most of the studies are made. Its direct occupation is, however, chiefly theoretical, considering with sufficient detail various dynamical points which arise from the suspension and different maintenances of the clocks and the derivation of a satisfactory differential equation of the motion when the internal resistance is taken into account. The solution of this equation presents some novelty, showing that the frequency in maintained motion is dependent upon the first power of friction, not the second, as has hitherto been held. The discontinuous maintenance is resolved into a Fourier series, and expressions are found for calculating the escapement error and the arc described in each case. In the case of the three clocks above the calculated arcs are numerically verified by comparison with their actual performance.

BOOKS RECEIVED.

Laboratory Glassware Economy. By Prof. H. B. Dunnicliff. Pp. x+92. (London: Macmillan and Co., Ltd.) 4*s.* net.

Hand Grenades. By Major G. M. Ainslie. Pp. v+59. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s.* net.

Text-Book of Ordnance and Gunnery. By Lt.-Col. W. H. Tschappat. Pp. x+705. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 30*s.* net.

A Text-book in the Principles of Science Teaching. By Prof. G. R. Twiss. Pp. xxvi+486. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7*s.* 6*d.* net.

A Short History of Science. By Prof. W. T. Sedgwick and Prof. H. W. Tyler. Pp. xv+474. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 12*s.* 6*d.* net.

A Text-Book of Physics for the Use of Students of Science and Engineering. By J. Duncan and S. G. Starling. Pp. xxiii+1081. (London: Macmillan and Co., Ltd.) 15*s.*

Applied Mechanics. Second Year. By H. Aughtie. Pp. 227. (London: G. Routledge and Sons, Ltd.) 2*s.* 6*d.* net.

Airfare of To-day and of the Future. By E. C. Middleton. Pp. xv+192. (London: Constable and Co., Ltd.) 3*s.* 6*d.* net.

The Edinburgh School of Surgery before Lister. By A. Miles. Pp. viii+220. (London: A. and C. Black, Ltd.) 5*s.* net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 21.

ROYAL SOCIETY, at 4.30.—The Scattering of Light by Spherical Shells, and by Complete Spheres of Periodic Structure, when the Refractivity is Small: Lord Rayleigh.—The Nature of Heat as Directly Deducible from the Postulate of Carnot: Sir Joseph Larmor.—Curved Beams: J. J. Guest.—(1) Monoclinic Double Selenates of the Iron Group; (2) Selenic Acid and Iron. Reduction of Selenic Acid by Nascent Hydrogen and Hydrogen Sulphide. Preparation of Ferrous Selenate and Double Selenates of Iron Group: Dr. A. E. H. Tutton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Switchgear Standardisation: Dr. C. C. Garrard.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

CHEMICAL SOCIETY, at 8.—Recent Studies on Active Nitrogen: Hon. R. J. Strutt.

LINNEAN SOCIETY, at 5.—Notes on the Bionomics, Embryology, and Anatomy of Certain Hymenoptera Parasitica, with Special Reference to *Microgaster connexus*, Nees: J. Bronté Gatenby.—Experimental Studies in the Specific Value of Morphological Characters in the Fungi: W. B. Brierley.

FRIDAY, FEBRUARY 22.

PHYSICAL SOCIETY, at 5.—Note on the Use of Approximate Methods in Obtaining Constructional Data for Telescopic Objectives: T. Smith.—A Suggestion as to the Origin of Spectral Series: Dr. H. Stanley Allen.

SATURDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

MONDAY, FEBRUARY 25.

ROYAL SOCIETY OF ARTS, at 4.30.—The Economic Condition of the United Kingdom Before the War; the Real Cost of the War, and Economic Reconstruction: E. Crammond.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Recent Journey in East Africa: Comte Renauld de Briey.

TUESDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 3.—A National Laboratory of Industrial Research: Sir R. T. Glazebrook.

ILLUMINATING ENGINEERING SOCIETY, at 5.—A Survey of Methods of Directing and Concentrating Light: Lieut.-Commander H. T. Harrison.

WEDNESDAY, FEBRUARY 27.

ROYAL SOCIETY OF ARTS, at 4.30.—Organisation of Commercial Intelligence: Sir W. H. Clarke.

THURSDAY, FEBRUARY 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Scattering of Light by Dust-free Air, with Artificial Reproduction of the Blue Sky. Preliminary Note: The Hon. R. J. Strutt.—The Lommel-Weber Ω Function and its Application to the Problem of Electric Waves on a Thin Anchor Ring: Dr. J. R. Airey.—Investigations on Textile Fibres: W. Harrison.—Critical Loading of Struts and Structure: W. L. Cowley and H. Levy.

FRIDAY, MARCH 1.

ROYAL INSTITUTION, at 5.30.—The Modern Dye-stuff Industry: Prof. A. G. Green.

SATURDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

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THURSDAY, FEBRUARY 28, 1918.

CHINSURA

THE NEW ERA IN MEDICINE.

Lord Lister. By Sir Rickman J. Godlee, Bart. Pp. xix+676. (London: Macmillan and Co., Ltd., 1917.) Price 18*s.* net.

THIS is a worthy biography of a very great man. Sir Rickman Godlee had to decide whether to write a literary biography in which the personality of Lister should be the central motive—a biography for the general reader—or, without neglecting this portrait, to build it, as wisely he has done, around his surgical and scientific occupations. The volume is, nevertheless, one to appeal not to medical readers only, but also to all men of science; and indeed to all those beyond who find an interest in the methods of discovery. The work is bulky, and some parts of it—for example the period of the failing light—might have been abridged; still on the whole this comprehensive book well reflects the life of toil and devotion which ransomed mankind from some of the most frequent and terrible of its pains and sorrows. Could the irony of things cut deeper than in that meeting of Lister in Pisa with a procession of the Archbishop in full dress, attended by ecclesiastics of various grades, chanting a prayer to Ranieri, the patron saint of the city, for his intercession against the cholera and the disease of the vines (p. 54). Now, as in all critical periods of medicine, surgery has led the way.

In the old maxim, to choose your parents wisely, Lister was not wanting. His father was a man of science of considerable and abiding distinction; and was moreover no inconsiderable scholar. The portrait of his mother speaks of a woman likewise of rare intelligence and refinement. And over the home rested the pure and gentle spirit of the Society of Friends.

Early in his life Lister was impelled to biological studies, and soon made his choice of the profession of medicine; but father and son were of one mind that, although scientific pursuits were by no means to be laid aside, yet a good literary and mathematical education should be pursued also, to the end of school life. Thus it was that Lister was well equipped as a scholar, and all through life he cherished not only that admiration which we all assume as we glance at our masterpieces sleeping in their presses, but also made them—Horace, Virgil, and Dante especially—the companions of his scanty leisure and holidays.

It has been said that Lister was but a plodder, a man rather of indefatigable industry than of imaginative genius. The truth is, imagination is of two chief kinds: the concrete, as in Reynolds, Turner, Keats, Rodin; the abstract, as in Newton, Maxwell, Pasteur, Darwin. In discoverers of this company, of which was Lister, the act of imagination consists, not in the building of æsthetic memories into an image, but in the conception and synthesis of principles, principles akin, but which, to ordinary vision, had been unseen or their kinship unrecognised. When on this perception of underlying affinity a new synthesis is revealed, it often comes in a flash, because the combining principles meet in the mind of a genius already vigilant and charged with prepared materials. Thus Pasteur's spark fell into a prophetic and impassioned mind already charged by vast and fertile labours, and by thought, experience, and foresight. The powder was ready and dry. The same essay by Pasteur that was shown to Lister by Prof. Thomas Anderson in 1865 had in the year before been shown to Spencer Wells, but the flash did not happen.

The "taking pains" part of genius, cherished, let us not forget, by his devoted wife, was in Lister almost stupendous. The present writer, who had the privilege of Lister's friendship, until he read this book had but an imperfect notion of its magnitude and variety; and behind it burned the sleepless passion of human love. He recalls one vivid conversation in which Lister described his restlessness, while house-surgeon to Syme, under this consuming passion. Driven by it, he would repair of an evening to the wards to reinvestigate the wounds, and again and again to scrape away fragments of tissues and discharges for examination by chemical and histological methods. Without this profound knowledge and experience of tissue perversions, controlled also by innumerable experiments, as upon the frog's web and bat's wing—methods devised by himself—he would have been as unprepared as were his surgical contemporaries to descry the power and the compass of Pasteur's discovery. We should add that in these preliminary researches he never ceased to proclaim his debt to Wharton Jones, and especially to Sharpey. And not only was Lister thus prepared beforehand, but his later bacteriological work also was far greater and richer than is generally appreciated. He invented the "hot box," and his were the methods of culture which held the field until they were superseded by Koch's solid media.

When the writer joined the honorary staff of the old Leeds Infirmary at least one-third of the amputations of the thigh were mortal. In the magnificent new building things were at first but little better; the ovariotomies—then a new and tentative operation, it is true—were so mortal that murmurs arose not only outside the hospital, but also within it. Yet in most instances these and such patients had been placed in single rooms apart, rooms as clean as housemaids could make them. What nevertheless that death-rate was I dare not try to remember. Suffice it to say that Erichsen was proud of results in which 25 per cent. of his major operations were mortal; of a certain 163 amputations Billroth lost nearly one-half—viz. seventy-five cases. In the hospitals of Paris generally the death-rate of major operations amounted to more than 50 per cent. In the London hospitals (1800 beds) the death-roll of all operations was no less than 38 per cent.!

We were all so proud of our housemaiding that when Rolleston, in his address on physiology at

Oxford, told us that much of the cystitis was due to our use of dirty catheters, and when Simpson proclaimed that our wards were so foul as to be fit only for a bonfire, we were incredulous and full of wrath. But in this book is told that story of the great magician under whose wand Syme performed his last twenty thigh amputations without a death! Erysipelas, septicæmia, gangrene, tetanus fled as gibbering ghosts before him.

But for a while these marvellous results were achieved only by the master and his reverent disciples; they were not bestowed upon the profane, or upon "slipshod surgeons." However, our limits forbid any discussion of the antiseptic and aseptic controversies, much of it a matter of words, or of the enthusiastic welcome of "Listerism" almost everywhere at home and abroad, except in London. For these and such stories we must be content to send the reader to Sir Rickman Godlee's book, in which every stage of the establishment of the gradually perfected system is described in its order, and the cardinal points developed in due proportion by an author who is almost silent upon the part played by himself in the new surgery. Moreover, in this case, that the life should have been written by a near kinsman proves to be altogether to our advantage. C. A.

MUSEUM MANAGEMENT.

The Museum: A Manual of the Housing and Care of Art Collections. By Margaret Talbot Jackson. Pp. xi+280. (London: Longmans, Green, and Co., 1917.) Price 6*s*. 6*d*. net.

IN the absence of any comprehensive handbook of museum management, this book serves a useful purpose. It is by no means exhaustive, and is written (quite naturally) from the point of view of American museums; but it contains many hints which the directors of English museums will find helpful. The author does not appear to have paid much attention to English museums; only ten are mentioned in her list of places visited (the Fitzwilliam and all provincial museums except Liverpool are omitted), as compared with forty-one German and seventy-nine Italian; and, apart from references to the print-mounts of the British Museum and a lighting device at the Ashmolean, practically no use is made of their experience. This, however, is no disadvantage from the point of view of museum officials in this country, but rather the contrary. We know our own practice, and what is helpful is to hear the experience of others, even though it may need adaptation before it is applied here.

Miss Jackson deals almost wholly with what may be called the body of a museum, not its soul. Only seven pages are devoted to the chapter on the formation of collections; but she has much to say, and says it sensibly, on the situation and architectural plan of a museum, on its walls, floors, and decorations, on the treatment and conservation of various fabrics and materials, and on questions of internal organisation and administration. On some points within this compass more might usefully be said; for example, on the relative advantages of small and large rooms. Small rooms are restful for the careful student who wishes to examine a few things and to examine them minutely; but they are wearisome to the general visitor, and are less easily warded. The true solution appears to be to have fair-sized galleries for the ordinary visitor, in which carefully selected objects are set out in the most instructive manner; and small rooms for the study series, and for a few special treasures, such as a Madonna di San Sisto or a Venus de Milo, which deserve the honour of solitary worship. There are few museums which are planned in this way, or which can spare the necessary space to set out objects with sufficiently wide intervals; but the ideal should be before the designers of new buildings.

A few other points may be noted. A word of caution is needed against the cross-lights and reflections which come from low windows on either side of a gallery and glass cases at right-angles to them. If peripatetic lectures are given in the galleries, some floor covering (such as cork linoleum) will save the lecturer's voice and the listeners' tempers. Variations of level between galleries, necessitating a step or two up or down, are a great obstacle to the transport of objects on trollies or barrows. More might have been said about designs of show-cases; the contents should not looked naked and unframed, but the case should provide a frame for the contents, without overpowering them by too much heaviness. If the museum is to be used at night, much thought is needed for the lighting, whether by ceiling lights or lights within the cases. But the omission which seems most serious is a fuller discussion of the labels and guide-books on which the main value of the museum as an educational agency depends. In America perhaps more reliance is placed upon lectures. In this country the lecturer is making progress as a museum institution, but he by no means replaces the descriptive label or the cheap, well-illustrated guide-book.

These are the few suggestions which space allows towards the improvement of a book for which museum curators should be grateful.

F. G. KENYON.

PLANT-ANATOMY IN RELATION TO EVOLUTION.

The Anatomy of Woody Plants. By E. C. Jeffrey. Pp. x+478. (Chicago, Ill.; The University of Chicago Press; London: Cambridge University Press, 1917.) Price 4 dollars net.

BOTANISTS for several years past have felt the need of a comprehensive text-book on the anatomy of plants worthy to take the place of de Bary's classic book published in 1877. As Prof. Jeffrey says: "In de Bary's text-book both palæobotany and development are deliberately eschewed." The omission of any account of the anatomy of extinct plants would in these days

be a much greater defect than it was forty years ago, and whether one agrees or disagrees with the conclusions stated by the author, he cannot be accused of undervaluing the importance of palæobotanical data. The study of the development of organs is deliberately omitted on the ground that it throws little light on the processes of evolution. The researches of Schwendener gave a stimulus to the study of anatomy from a physiological point of view, and the last edition of Haberlandt's "Physiological Plant Anatomy" admirably represents the present state of our knowledge in this branch of botany. It is surprising that Prof. Jeffrey makes no reference to Haberlandt's work.

"The Anatomy of Woody Plants" cannot be said to be a comprehensive text-book; the treatment is essentially eclectic, and the subject-matter is to a large extent limited by the scope of the author's well-known and invigorating researches. The main object is to interpret the structural features of recent and fossil woody plants in terms of descent. An anatomical treatise on broader lines, in which the anatomy of the lower plants receives adequate treatment, has still to be written.

Prof. Jeffrey believes that the herbaceous type of dicotyledon is derived from ancestors with woody stems, and in this connection the different types of medullary rays are fully discussed. The illustrations are excellent, the great majority being new. Chaps. i.–x. treat of the cell, tissue-systems, fibrovascular tissues, the epidermis, and fundamental tissues. Special attention is given to the structure of the secondary xylem. "We have," says the author, "in the woody structures past and present an almost perfect biological document, carrying back the history of plants in relation to their changing conditions of environment into remote epochs of our earth's history."

Much interesting and to a large extent new information is given about the elements of woody tissue, tracheids, vessels, fibres, etc., based on the examination of macerated material. Arguments are adduced in support of the view that "the distinction between spring and summer tracheids did not exist in the case of Palæozoic woods," a statement—implying, as it does, the prevalence of uniform climatic conditions throughout the Palæozoic era—scarcely consistent with the geological and botanical evidence afforded by the Glossopteric flora and the rocks associated with the Permo-Carboniferous plant-beds of Gondwanaland. Rings of growth, though generally lacking in Palæozoic stems from European localities, are far from being universally absent. An annual winter period of rest is believed to be the cause of the appearance of longitudinal parenchymatous elements in wood. Attention is paid to the root, stem, leaf, microsporangia, and seeds, and there is an interesting chapter on the canons of comparative anatomy. Chaps. xviii.–xxix. are devoted to the Lycopsida, Pteropsida, Gymnosperms, and Angiosperms; chaps. xxx.–xxxii. include anatomical structure and climatic evolution, evolutionary principles exhibited by the Compositæ, and a very useful account of anatomical technique.

Prof. Jeffrey's book, which is admirably produced by the Chicago Press, is an original and stimulating contribution to botanical literature. The author discusses various controversial questions and raises many points on which there is considerable difference of opinion. His views on the primitive nature of the Abietineæ and their greater antiquity than the Araucarineæ are stated with an assurance that is almost pontifical. Too little weight is attached to the study of reproductive organs, and the very strong evidence of the records of the rocks in favour of the greater antiquity of the Araucarian stock is either ignored or very partially treated. There are no references to the published work of other authors, and no bibliography—a very serious blemish in a book which is presumably intended for students unfamiliar with the widely scattered original literature, and ought to be a guide to those who wish to go further along particular lines of inquiry and to see what has been said on the other side.

The fact that Prof. Jeffrey is an original investigator whose position entitles him to speak with authority increases one's regret that his attitude is not more in keeping with the best traditions of scientific exposition. A. C. SEWARD.

OUR BOOKSHELF.

Telegraph Practice: A Study of Comparative Method. By J. Lee. Pp. ix+102. (London: Longmans, Green, and Co., 1917.) Price 2s. 6d. net.

OF books on the art of electric telegraphs, covering more or less completely technical details and principles of the numerous types of apparatus, there has been an increasing, and it may be even a more than ample, supply. That the science of telegraphy has not been equally well served is probably due to the artificial elimination in England of the engineer from any sufficient practical direction of the method of utilising the machines which he designed and installed. However that may be, the appearance of Mr. Lee's book at once brings the fact into prominence and goes a long way towards filling the gap which it reveals. Mr. Lee's long association with the traffic control organisation of the British Post Office has placed him in an excellent position to ascertain all the factors of the numberless problems of the science of telegraphy; and his admirable powers of grasping the facts and of presenting them in a concise and cogent manner render this little book of 100 pages a storehouse of valuable details and a veritable handbook for the expert. It is withal a very attractively readable description of one of the most valuable of modern "utilities." It is a "study" of telegraph practice which, while glancing at the past, deals in a comparative sense with the present, and indulges in illuminating conjecture in regard to the future. The author regrets that the name of the originator of an ingenious method of classifying Press telegrams is unknown; if he should wish to know who originated the "indicator" word of

registered telegraphic addresses which he describes on another page the present writer might be able to enlighten him.

The author's outlook on telegraphy is that of the optimist who knows, and of the prophet who, by a balanced consideration of the past, can foresee and frame a just conception of the future, and is thereby enabled to point forward "to a time when telegraph practice will . . . serve the economic and industrial and social needs far more vitally and far more intelligently than it has been called upon to do in the past." A. J. S.

Thomas A. Edison: The Life-story of a Great American. Pp. 216. (London: G. G. Harrap and Co., 1917.) Price 3*s*. 6*d*. net.

THE name of no great man of science or inventor is so familiar to the "man in the street" as that of Thomas Alva Edison, and the anonymous volume before us purports to give some account of his life and work. The eight chapters bear no titles, but are prefaced by rather sensational contents-headings, including such phrases as "Apprenticed to Magic," "Edison the Napoleon of Modern Times," "Let there be Light," "And this Light emanated from America," etc. The author succeeds in conveying a vivid picture of the manifold activities of his hero, but, while tracing in chronological order Edison's various achievements, the text consists largely of a series of thumbnail sketches of the man and of episodes in his career, interspersed with extravagant eulogies which will grate a little on the minds of sensitive readers.

The descriptions of the inventions will convey very little to readers who are not already familiar with them, and those who are will regret the neglect to give credit to any but Edison and his personal assistants. Thus, while ample space is accorded to Edison's world-wide search for a suitable fibre for his incandescent lamp, Swan's name is not mentioned. Again, one would imagine that the kinematograph was wholly Edison's invention. As a matter of fact, he was preceded on the photographic side by Muybridge and by Marey, and did not, in the first instance, carry his apparatus beyond the peep-show stage. The credit of first projecting the pictures upon a screen from a film belongs to R. W. Paul in England and to Lumière in France. E. C.

French Scientific Reader. Edited, with Introduction, Notes, and Vocabulary, by Dr. Francis Daniels. Pp. xvii+748. (New York: Oxford University Press; London: H. Milford, 1917.) Price 10*s*. 6*d*. net.

DR. DANIELS has compiled a judicious anthology from the great scientific papers of a number of distinguished French men of science, among whom, to name a few, may be mentioned Laplace, Pasteur, and Fabre. The book will serve several purposes: it provides ample material for a course in scientific French for students preparing for graduation in science; it brings out convincingly the peculiar fitness of the French language to serve as a medium of scientific expression; and it will give readers sound ideas of the development of modern science.

The selected passages cover very fairly the various branches of physical and biological science; the copious vocabulary will largely dispense with the need for a dictionary; and the notes, of which there are sixty-five pages, will provide teachers of French with the information necessary to enable them to understand the text.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

British Scientific Instrument Makers' Research.

READERS of NATURE may be interested to hear that the recommendation made by Mr. E. S. Hodgson in the issue of February 7 has been anticipated by the optical trade.

The British Optical Instrument Manufacturers Association is an organisation which was formed in the early part of the war, and includes almost all the important manufacturers. This association has co-operated with the Ministry of Munitions in increasing the output of optical munitions with a degree of success that could not have been expected. It has energetically assisted in the formation of the new Opto-Technical Educational Institute under the Imperial College of Science and Technology at South Kensington, and has now so far completed negotiations with the Department of Scientific and Industrial Research that it is scarcely premature to say that a Scientific Instrument Research Association under the auspices of that Department will be in existence almost immediately.

The trade association is for the present fully occupied with the new requirements for military and naval purposes, but it has a Technical Committee, which includes the best expert optical knowledge of the country, that would be glad to place its experience at the disposal of all departments which require problems to be investigated or requirements to be met.

Applications should be made to the Secretary, 6 Moorgate Street, London, E.C.2.

CONRAD BECK,
President, British Optical Instrument Manufacturers' Association, Ltd.

Alcohol Fuel and Engines.

IN the sympathetic notice in NATURE of October 18, 1917, of the first report of the Special Committee on Alcohol Fuel and Engines of the Australian Commonwealth Advisory Council of Science and Industry attention is directed to the part that benzol, obtained from the distillation of coal, may play, after the war, as a substitute for petrol. Undoubtedly in Great Britain very large quantities of this fuel will be available for peaceful purposes, but in Australia very small quantities of it will be produced.

The terms of reference of the Committee specify the use of fuel that may be produced in Australia, and hence, as the writer of the article in NATURE supposes, practically do not cover the use of benzol.

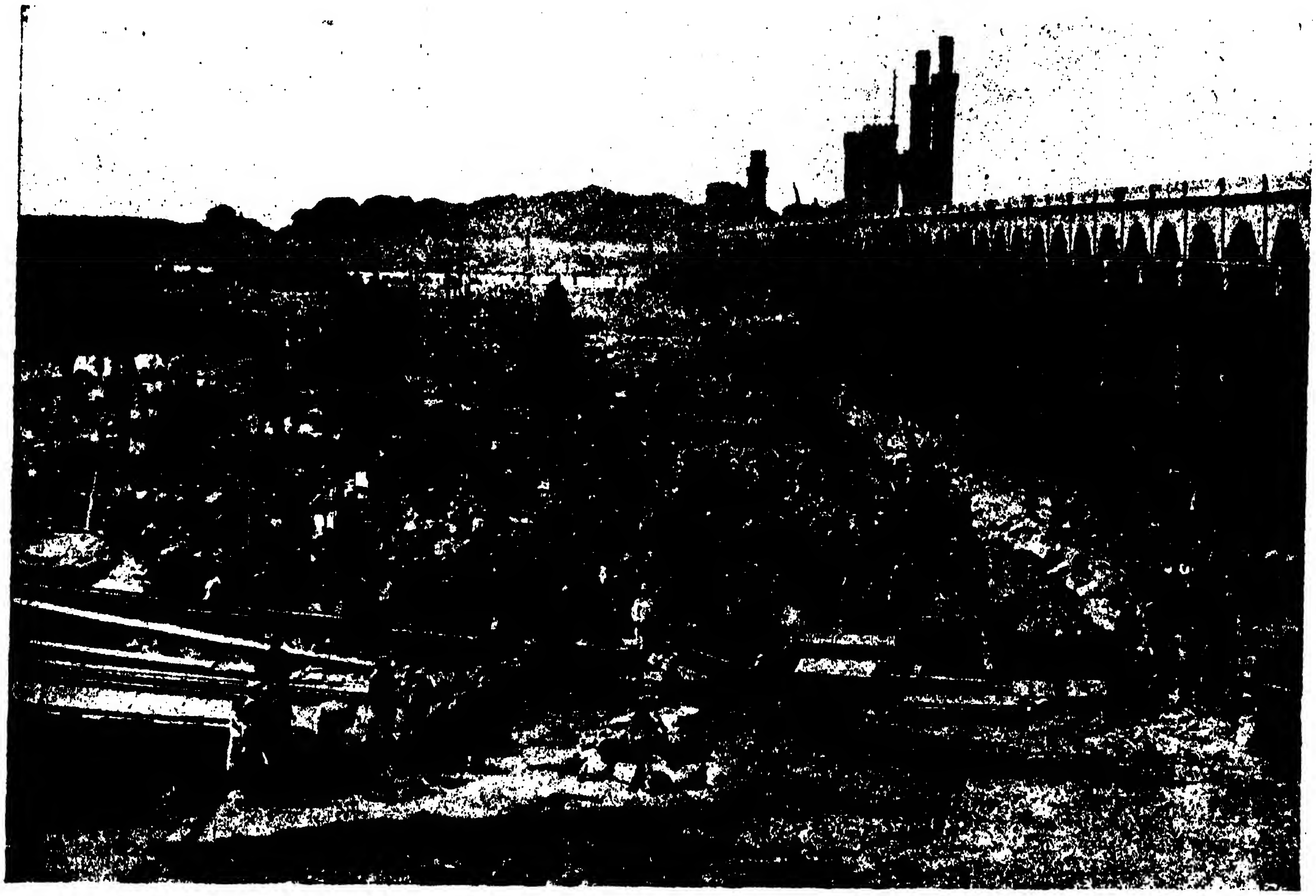
At the same time the Committee has not neglected the possibilities of using mixtures of alcohol and benzol which, as is well known, enable the engine to be started with greater ease than if alcohol alone were used.

THOMAS R. LYLE,
Chairman of Special Committee on Alcohol Fuel and Engines.

314 Albert Street, East Melbourne, January 8.

THE PREFECT OF THE NILE.[1]

THE name of Sir Colin Scott-Moncrieff is inseparably associated with irrigation, and pre-eminently with Egyptian irrigation—not in the sense, perhaps, of an initiator or pioneer, but as one who found a great undertaking in a state of almost hopeless ruin and decay, and by dint of indefatigable exertions and unremitting toil restored it to a position of efficiency and importance far exceeding anything in its previous history. Sir Colin did not himself design or build the great barrage at the head of the Nile Delta, which, for more than a generation prior to the erection of the more renowned structure at Assuan, furnished Egypt with fertile inundations, rich in potential



Nile Barrage, Damietta branch. From "The Life of Sir Colin C. Scott-Moncrieff.'

crops of corn and cotton and sugar: this was the achievement of an accomplished French engineer, Mougel Bey, who towards the close of his life unfortunately sank into poverty and obscurity. It is narrated in the biography before us that Sir Colin took a keen delight in hunting up the old man to acquaint him with the fact that his *magnum opus* had been successfully repaired and was holding up 10 ft. of water.

"Ten feet!" Mougel repeated several times, deeply moved, and then cried out: "I knew that my design was sound. I knew it would be justified in the end."

It is thoroughly characteristic of Sir Colin that he not only refrained from the least depreciation of the labours of his predecessor, but, urging the merit of the latter's services, he secured for him a welcome pension.

Yet, despite the absence of originality, the work actually carried out by Sir Colin was scarcely less important than the execution of the primary design. He found the barrage had been so neglected that the whole fabric was decrepit, the masonry being cracked by unequal settlement, the timber rotten, and the ironwork a mass of rust. Pressed on all sides to abandon as hopeless any idea of its restoration, he refused to be deterred, and, aided by certain engineers of the Indian Public Works Department—Major Justin Ross, Major (now Sir R.) Hanbury Brown, Mr. (now Sir) W. Willcocks, and Mr. E. P. Foster—he had the piers underpinned and the superstructure renewed until, as stated above, a serviceable degree of staunchness was obtained and the water once more began to fill the distributary canals. "My Nile is behaving itself," he wrote proudly to his sister, Mrs. Robertson, in September, 1885.

The service rendered to Egypt, and especially to Egyptian agriculture and commerce, can scarcely be overrated. From a state of acute depression and chronic lethargy, cultivation steadily increased in extent and importance, until, before he quitted his post, Sir Colin had the satisfaction of seeing his expectations realised and the country once more set on the way towards a prosperity which it had not experienced for many centuries. The qualities which enabled him to achieve such a result were "a high degree of practical wisdom,

[1] "The Life of Sir Colin C. Scott-Moncrieff." Edited by his Niece, Mary Albright Hollings. Pp. xii+374. (London: John Murray, 1917.) Price 12s. net.

energy, decision, promptitude, discernment"—this is the judgment of the Under-Secretary for Scotland, Sir James Miller Dodds.

The Nile is unique in its interest for the geographer, the man of science, and the engineer. India and other semi-arid countries have some rainfall, however scanty. In Egypt there is none: the Nile compensates for the deficiency. The floods of the great river, carrying down alluvial detritus from the mountain slopes of Abyssinia, and mud from the marshy tracts of Central Africa, sweep over the fields of Lower Egypt and saturate them with fecundity. So soaked is the soil that, as soon as sown, wheat and barley spring up to maturity without a single drop of further moisture. To a natural endowment, so profuse and plentiful, there is only one drawback—its intermission. It fell to Sir Colin's lot to regulate and control, to distribute and allocate the precious waters, and he discharged the duty thoroughly and well.

Of his operations of a similar nature in India, scarcely less important in scope, though perhaps not so notable in execution, there is not room here to speak. Both it and the other outstanding events of an eminently useful and busy life will be found recorded in the biography, edited by his niece, the perusal of which has been full of interest. In the strict sense of the word Sir Colin Scott-Moncrieff was, perhaps, not a great engineer, but he was undoubtedly a great administrator, having a wonderful capacity for organisation, rare tact, and unlimited patience. Could anyone desire a better epitaph than the simple words of Lord Milner which conclude the volume: "He leaves a fine record of work, and will be remembered as one of the best beloved of men"?

BRYSSON CUNNINGHAM.

A NEW BRITISH OIL INDUSTRY.

THE strenuous and anxious times through which this country is now passing have been fruitful in many lessons which, it is earnestly to be hoped, will have a profound and permanent influence upon its national character and habits. Now that we are in one of the most critical epochs in our history, we have become painfully conscious to what an extent our negligence and shortsightedness in the past have contributed to our present jeopardy. We see plainly enough now that if we had only paid greater heed to many things that affect our national well-being, our resources in the contest and our confidence in its outcome might have been enormously strengthened. The struggle has been prolonged in large measure by the fact that we were unprepared for it, and we are constrained to admit that the lack of preparation has not been creditable to us as a prudent, well-ordered, and right-thinking community.

We see the evidences of this at almost every turn, and nowhere is it more apparent than in the manner in which we waste our natural resources, or at least imperfectly utilise them. The present condition of our food supply is, of course, the greatest and most outstanding instance of our neglect of an industry which is at the basis of our welfare, and even of our very existence as a nation. But there are other, even if less important, matters in which we have shown ourselves negligent of our opportunities and to which we have, at length, been awakened partly by the insidious dealings of our enemies, and partly by our recognition of their greater energy and alertness in the application of science and scientific method to industry and the practical affairs of life. Thus we have been so wrapped up in the production of iron and steel that we have paid little heed to the non-ferrous metals, although by a little more energy and enterprise we could just as readily as Germany have contributed our fair share to the world's requirements. So, too, in the manufacture and utilisation of the by-products in the coking of coal, there can be no question that the manner in which we have squandered our greatest natural asset in the past has been nothing short of a national scandal.

It has needed the pressure of our present emergency to induce us to quicken our attempts to remedy a condition of things which should never have been allowed to arise. Our immediate shortage of mineral oils as illuminants and as fuel is a further instance of our neglect of the potential sources of supply existing in our own country, and it is only the submarine menace that is, apparently, impelling us to exploit them. The attempts to utilise the Kimmeridge shales of Dorset and Norfolk have as yet led to no practical result; there are difficulties with the Treasury and the Legislature; it may be also that the technical difficulties of desulphurisation have proved to be almost as insurmountable. But there are other oil-shales than those of Kimmeridge, and also cannels and torbanites, as well as blackband ironstones and lignites, which might be turned to account as indigenous sources of mineral oils. Some of these are, of course, worked by the Scottish shale-oil companies, which, after a long struggle with adverse conditions, are now, in the special circumstances of the time, exceedingly prosperous. But there is still room for a considerable extension of the industry, as the production of these companies, not only in oil, but also in the by-products of sulphate of ammonia and paraffin-wax, falls far short of the country's needs.

In a series of papers communicated to the Institution of Petroleum Technologists on February 19 attention was directed to certain sources of supply of oil which have hitherto been entirely neglected; these are the deposits of cannels, torbanites, and blackband ironstones—many of them cheaply and easily obtained and readily worked. Mr. Cunningham Craig described the characteristics and mode of occurrence of these "kerogenous" or petroliferous materials, and explained how their petrographic analysis serves to reveal the nature of the products of their distillation. He pointed out how wasteful has been the method of treating the blackband ironstones, whereby all the valuable volatile contents of the

intermingled carbonaceous matter have hitherto been dissipated in air. It can be shown that the oil contents of a blackband seam, as well as the ammonia, can be extracted by distillation, and fixed carbon left in intimate association with the ferric oxide, so that the ironstone is in a better condition, both chemically and physically, for treatment in the blast-furnace, leading to a considerable saving of coke, a readier extraction of metal, and less wear-and-tear of the furnace. Mr. Craig boldly faced the economics of the question, and explained in detail the conditions upon which the commercial success of treating the cannels and associated minerals by the method he indicated must depend; and he showed how it compares, as a business proposition, with the well-established Scottish industry.

Dr. Mollwo Perkin contributed a short paper on the relative merits of high- and low-temperature carbonisation, with special reference to the production of fuel-oil; and gave the results of a number of trials with different coals at low temperatures, say 450–550°, showing the very great variation in yield under substantially the same conditions. The average quantity of fuel-oil obtainable from one ton of cannel may be put at 20 gallons. If 15,000 tons of cannel were carbonised per diem, it would amount to 105 million gallons of oil per annum, working the plant for 350 days in the year—no inconsiderable proportion, therefore, of our present needs.

Mr. Berry and Dr. Dunstan dealt more particularly with the chemical and analytical questions involved, such as the modes of sampling the cannel; the determination of the yield of oil; the products of retorting; the chemical nature of cannel oil; effects of temperature on its character; its refining, and fractionation; calorific values and other physical data.

The papers together form a valuable contribution to a subject of special importance at the present time; they serve, moreover, to direct attention to the possibility of a new and permanent British industry, and deserve, therefore, the thoughtful consideration of all who are interested in the development of our national resources.

THE ORGANISATION OF RESEARCH IN AGRICULTURE.

OF the results of the war, not the least remarkable is the awakening of interest in the application of scientific research to economic objects and the readiness of the State to endow industrial investigations of all kinds; and yet the admitted pre-eminence of Germany in the technical applications of scientific knowledge does not jump to the eyes in the apparatus or operations of war. She cannot even claim priority in her inhumanities. The use of poison-gas was suggested to our War Office soon after the Crimean War and unhesitatingly rejected. Nor has the extraordinarily lavish expenditure of Germany on abstract, as well as industrial, research been productive of very marked new additions to knowledge. The root of the matter must be sought elsewhere. In a paper read by M. Georges Wery [1] at a conference held in Paris last June and presided over by the Minister of Agriculture, one finds attention directed to what is really the dominant characteristic of the German people in relation to this matter—a characteristic to which much of their recent advance in efficiency may be ascribed.

The German people, as a whole, believe in the economic value of knowledge, respect the scientific method, are eager to give practical effect to the results attained by that method, and, as a result, are ready to submit their industries to scientific direction. It will avail us little to endow scientific research unless scientific knowledge is deferred to more than it has been in the past. The fond belief that scientific results can be ordered and paid for like goods, and that the knowledge which gave these results birth has no continuing industrial value, must be abandoned, if we set out to compete with the German in his own field. The attitude of the public generally, and particularly that of the leaders of industry, must change.

The main purpose of M. Wery's paper is to give an account of the organisation of research in agriculture in foreign countries, and to contrast the comparatively meagre provision made in France for this object with that made in Germany and America. He points out that Germany has no fewer than ninety-nine institutions, comprising 162 distinct laboratories, devoted to research in agricultural subjects, all of which are in receipt of State subventions. Prussia alone has fifty-eight institutions of this nature, all of which have large staffs, "luxurious" laboratories, and ample equipment. As evidence of the hold which scientific work has gained on the German agriculturist, M. Wery cites the remarkable fact that some years ago the German farmers and landowners raised a sum of a million and a half sterling, which they presented to the Emperor for the purpose of founding industrial and agricultural laboratories. No better evidence could be given of the fundamental difference between the attitude of the German agriculturist to science and that taken up by the English farmer. The gross revenue of the agricultural research stations in Germany approaches 400,000*l.*—a sum which M. Wery effectively contrasts with the parallel figure in France of 60,000*l.*; he might have added the corresponding English figure, which is less than 40,000*l.*! But even the German figure pales before the American total of 1,000,000*l.*

It is pointed out that the German organisation of research was not without what may be termed a publicity value in the past. The admiration which it excited, if not calculated to assist the sale of German goods, at any rate led to the exploitation of German "Kultur" in England and created a demand for the German savant outside his own country—results which, no doubt, were indirectly of economic value to the Fatherland. M. Wery is on sure ground when he proceeds to

[1] *Bulletin de la Société d'Encouragement pour l'Industrie Nationale.* No. 5, 1917.

dwell on the limitations of German scientific work in its useless elaboration of details, its devotion to the accumulation of mere data, and its purely material objects and results; and when he claims for France a greater number of discoveries of the first rank, a greater love of knowledge for its own sake, we can heartily agree. "The bright sunlight," he says characteristically, "which illumines the footsteps of Descartes, Lavoisier, and Pasteur will indeed be obscured, if the fogs which rise from the plains of Germany come our way."

We may also quote the author's plea for a minimum of State interference. "Discoveries," he says, "are not made by the stroke of a magician's wand. *L'esprit souffle où il veut.* What the State should provide for the savant is the *means* for research. It should not impose methods or predetermined ideas; otherwise all initiative will be stifled." We may join with M. Wery in hoping that his plea in the interests of the extension of scientific research in agriculture in France will prove successful. The country which produced a Boussingault and a Pasteur must not be suffered to lag behind.

NOTES.

In the course of his statement on the Army Estimates, in the House of Commons on February 20, Mr. Macpherson directed attention to the health of the troops in the various theatres of war. In the Napoleonic campaigns 97 per cent. of the total deaths were from disease and only 3 per cent. were on the battlefield. In the South African campaign 67,000 cases of disease were admitted into hospital, of whom more than 8000 died. In France up to November last the deaths from disease were only one-fourth of the number that died from the same cause in South Africa. In Macedonia conditions are not so satisfactory, but as a result of the hygienic measures taken the amount of sickness in 1917 was reduced to two-thirds, and the death-rate to one-third, of what it was in 1916. A well-deserved tribute was paid to the Army Medical Service and to the services which had been rendered by the retiring Director-General, Sir Alfred Keogh.

Dr. Fleming Sandwith, C.M.G., died suddenly and unexpectedly on February 17. He was in his sixty-fourth year, and had been invalided home after two strenuous years in Egypt. Few civilian medical men could show such a record of military service. He had worked in the Turko-Serbian war of 1876, and in the Russo-Turkish war in the following years. He had been on Baker Pasha's staff, and was senior physician to the Imperial Yeomanry Hospital in the South African war. In December, 1915, he was appointed temporary colonel in the Royal Army Medical Service, and proceeded to Egypt, a country well known to him, for in 1883 he was appointed for preventive work there against cholera. In Egypt Dr. Sandwith remained many years engaged in sanitary work and private practice, acquiring a considerable reputation in tropical medicine. After the South African war he settled in London, and became lecturer in tropical diseases to St. Thomas's Hospital, physician to the Seamen's Branch Hospital, Albert Dock, and lecturer in the School of Tropical Medicine there. He was also Gresham professor of physic, and his lectures on such subjects as plague, Pasteur's life and work, insect carriers of disease, etc., were deservedly popular. A man of genial and kindly disposition, Dr. Sandwith will be missed by a wide circle of patients and acquaintances.

The Minister of Reconstruction, Dr. Addison, has appointed an Advisory Council to assist him in considering the many proposals that come before his Department for review. The work of the Council is to be discharged through four sections, each of which will advise the Minister on specific questions referred to it by him within the general subjects allocated to the several sections, namely:—Section I.: Finance, transport, and common services; Section II.: Production and commercial organisation; Section III.: Labour and industrial organisation; Section IV.: Social development (including rural reconstruction). The Council at presents consists of thirty-seven members, among whom are the following:—Mr. C. R. W. Adeane, late president, Royal Agricultural Society; Sir Richard Glazebrook, director of the National Physical Laboratory; Mr. H. J. Mackinder; the Hon. E. G. Strutt, an authority on agricultural questions; and Prof. T. B. Wood, professor of agriculture, Cambridge University. Mr. Eustace Davies, of the Ministry of Reconstruction, has been appointed secretary to the Advisory Council. It is noteworthy that while engineering, agriculture, industry, labour, the law, finance, and politics all have their representatives, pure and applied science, other than engineering and agriculture, is represented by one member only. Presumably Section IV. will be concerned with such problems as the welfare of workers and housing for the people, yet there is not a single member representing medicine and hygiene or architecture.

Sir G. Cave announced, in the House of Commons on February 20, that for the present year summer-time will be brought into force on the morning of Sunday, March 24, and will continue until the night of Sunday, September 29, an arrangement that will give an additional five weeks of summer-time this year. He added:—"As regards the suggestion that during the midsummer period the time should be advanced by an additional hour, there is no power under the statute to make this further change, and I may add that the Committee which had the proposal before them reported unanimously against it." The agricultural correspondent of the *Times* points out in Tuesday's issue, what we urged on many occasions when the "daylight saving" principle was under discussion, namely, that agricultural interests were ignored by it. Referring to the introduction of summer-time in the fourth week of March, he remarks:—"The drawback is that much of the early morning work at the homestead—the grooming and feeding of horses, the feeding and milking of cows, and the dispatching of the milk—will have to be done by artificial light, which means additional expense, and the prolongation of the period of dark mornings makes the farm less attractive for those whom it employs. The dairy farmer is especially affected, and there are cases in which milk production has been abandoned chiefly because of the labour trouble arising from the operation of the Daylight Saving Act. The most serious disadvantages suffered by the farmer, however, occur from June onwards. The early dews that are no great hindrance at seed-time are a definite hindrance to progress when the work of saving the crops begins. From the time when haymaking is begun in June until the last of the cereals is gathered in September or later, an hour in the late afternoon is often worth two in the morning; yet the farmer finds himself compelled to make good at the cost of overtime the hour that has been deducted from the morning of his normal day. Because of the ad-

verse effect on the harvesting of the crops the extension of the period in September is far more perturbing than the earlier beginning, although both are prejudicial to the farmer and his work."

MR. THOMAS TYRER, who died suddenly on February 20, at seventy-five years of age, received his early chemical training under Hoffmann at the Royal College of Chemistry. In 1862 he was employed as works chemist by Messrs. May and Baker, manufacturers of fine chemicals, of Battersea, and later became managing director of the firm. For the past eighteen years he controlled the works bearing his name at Stratford, established in 1844, where a number of fine chemicals and pharmaceutical preparations are manufactured. Mr. Tyrer was very intimately associated with the Society of Chemical Industry since its foundation in 1881. He was a member of the original Publication Committee, on which he served continuously until his death, for many years hon. secretary of the London Section, and president for the session 1897–98, as well as having been chairman of the London Section, and serving on the council during the greater part of the existence of the society. Since 1907 he had been hon. treasurer of the society, a position which he filled with great ability. His devotion to the society throughout was very notable, and he spent a large amount of time in furthering its interests. In recognition of his services to the society and to chemical industry, the society's medal was presented to him in 1910. Mr. Tyrer served on the governing board, and also on the executive, of the National Physical Laboratory, and he was a member of the council of the Association of British Chemical Manufacturers. For many years, too, he took a very active part in the efforts to secure relief from the duty on alcohol for use in arts and manufactures, which eventually resulted in considerable concessions being obtained from the Inland Revenue. He was keenly interested in the Chemical Section of the London Chamber of Commerce, of which he was chairman at one time, and took an active part in the work of the Alcohol Motor Transport Council. It may also be mentioned that he was one of the first members of the old London School Board. Mr. Tyrer was a man of remarkable personality and great energy; he was widely known in chemical, industrial, and pharmaceutical circles, and will be greatly missed.

DR. C. D. WALCOTT, secretary of the Smithsonian Institution at Washington, has been elected correspondant of the Paris Academy of Sciences in the section of mineralogy in succession to Sir Archibald Geikie, who has been elected foreign associate.

DR. FRANK SCHLESINGER, director of the Allegheny Observatory, has been appointed aeronautical engineer in the U.S. Signal Corps. He will have charge of the instruments that go on aeroplanes, and will form the connecting link between the corps and the National Research Council. During his temporary absence from the observatory Dr. Frank C. Jordan will be in charge.

THE work hitherto done by the Economy Section of the Ministry of Food has now been allotted to four new branches of the Ministry, as follows:—(1) Public Services Food Consumption Branch: Director, Major G. Henderson; (2) National Kitchens Branch: Director, Mr. C. F. Spencer; (3) Public Catering Branch: Director, Mr. A. Towle; (4) Educational Branch: Director, Prof. E. H. Starling. The co-ordination and control of the policy of these Departments will be exercised by a Board to be called the Food Survey Board, of which Lt.-Col. A. G. Weigall will be chairman.

WE record with regret the death, on February 23, of Lord Brassey, in his eighty-third year. Lord Brassey was best known, perhaps, for his voyages in the *Sunbeam*. In 1879 he was president of the Royal Statistical Society, and in 1893–95 president of the Institution of Naval Architects. He was the founder and first editor of the *Naval Annual*, and the author of several works on social economics.

WE regret to see, in the *Chemical Trade Journal*, the announcement of the death, from injuries caused in a cycling accident, of Prof. E. A. Letts, professor of chemistry in the Queen's University, Belfast. He was a fellow of the College of Surgeons and of the Royal Sanitary Institute. In 1876 he was appointed the first professor of chemistry in University College, Bristol. Among his numerous writings are "The Pollution of Estuaries and Tidal Waters" and "Some Fundamental Problems in Chemistry."

THE death is announced, in his seventy-third year, of Mr. C. E. Faxon, who had been assistant director of the Arnold Arboretum, Jamaica Plain, Mass., since 1882. Mr. Faxon was best known as a botanical artist. He was selected by the Smithsonian Institution to make the drawings for Sargent's "Silva of North America." He had also illustrated Sargent's "Forest Flora of Japan" and "Manual of the Trees of North America," Eaton's "Ferns of North American Garden and Forest," and many other botanical publications.

MR. C. R. DODGE, who for ten years was in charge of the museum of the U.S. Department of Agriculture, died recently in his seventy-first year. In 1890 that department appointed him as its special agent to conduct important fibre investigations. He was the author of twenty special reports on that subject, and also of a "Dictionary of the Fibre Plants of the World." Mr. Dodge represented the United States at the Paris Exposition of 1900 as director of its agricultural commission. He was a chevalier of the Legion of Honour.

THE annual general meeting of the Institute of Metals is to be held on March 13 and 14 in the rooms of the Chemical Society, Burlington House, Piccadilly, W.1. On the first day, when the meeting begins at 8 p.m., the president-designate, Prof. H. C. H. Carpenter, will be inducted into the chair, and the presidential address will be delivered. On March 14, beginning at 4 p.m., several technical communications will be submitted and discussed.

THE *Engineer* for February 22 announces the death of three well-known members of the Institution of Engineers and Shipbuilders in Scotland: Mr. W. Cuthill, who was late works manager of the Blochairn Works of the Steel Company of Scotland; Mr. J. Kennedy, who for forty years was superintending engineer with the firm of R. MacAndrew and Co., and was a founder and chairman of both the Glengall Ironworks and the British Arc Welding Co.; and Mr. J. A. McKie, who founded the firm of McKie and Baxter, engineers and shipbuilders, of Copland Works, Govan.

THE officers and council of the Physical Society of London for the ensuing session are to be as follows:—*President*, Prof. C. H. Lees; *Vice-Presidents* (in addition to those who have filled the office of president), Prof. J. W. Nicholson, Prof. O. W. Richardson, Dr. S. W. J. Smith, and Dr. E. W. Sumpner; *Secretaries*, Prof. W. Eccles, City and Guilds Technical College, Leonard Street, E.C.2, and Dr. H. Stanley Allen, King's College, London, W.C.2; *Foreign Secretary*, Sir R. T. Glazebrook; *Treasurer*, Mr.

W. R. Cooper; *Librarian*, Dr. S. W. J. Smith; *Other Members of Council*, Prof. E. H. Barton, Mr. C. R. Darling, Prof. G. W. O. Howe, Dr. D. Owen, Mr. C. C. Paterson, Mr. C. E. S. Phillips, Dr. S. Russ, Mr. T. Smith, and Mr. F. J. W. Whipple.

MR. H. G. BEASLEY describes, in the February issue of *Man*, a remarkable form of wooden hook, known as Matau Hokori, from Greenwich Atoll, the greatest length of which is 7¾ in. It is the crudest specimen hitherto received from the Pacific, formed from a natural root of a pale-coloured wood, of light weight. The maker scarcely troubled even to remove the notches, and in many places has left the bark intact. The barb is of similar wood, and shows a certain amount of skill in the way it is scarfed to the shank; it was apparently finished with some blunt implement and afterwards with a rasp. The hook is a poor specimen of Polynesian art, but this is not surprising considering the remoteness of this little group of islands and the smallness of the population.

"RECONSTRUCTION and Public Health" is the subject of an article by Mr. E. J. Lidbetter in the *Eugenics Review* for January (vol. ix., No. 4). Mr. Lidbetter points out that public health administration has hitherto been based upon prevention in the economic sense, and is not concerned with the individual, who is dealt with under the Poor Law. He pleads for co-ordination between the public health service and organisations for the treatment of individual sickness, *e.g.* the hospitals, and the divorce of Poor Law administration in the treatment of the sick independent members of the community.

IN the November issue of the Journal of the Quekett Microscopical Club (vol. xiii., No. 81) Mr. W. M. Bale describes a method for the measurement of magnifying powers. The method is as follows:—Measure the exact diameter of the magnified field projected with a camera lucida or Beale reflector at a distance of 10 in. Measure also with the stage micrometer the actual diameter of the field. Then the first figure divided by the second gives the magnifying power. But a small correction has to be made, because in the camera image the magnification is appreciably greater at the marginal portions of the field than near the centre. This varies from 1 mm. with a 4-in. field (101 mm.) to 9 mm. for a 9-in. field (203 mm.), being at the rate of 1 mm. for every ½-in. increase in the diameter of the field. Mr. Maurice Ainslie gives some further notes on this method, and describes an alternative method by the measurement of the Ramsden disc.

THE annual report on the Agricultural Department, St. Vincent, for the year ended March 31, 1917, contains a further account of the work being done to control the ravages of the cotton-stainer (*Dysdercus delauneyi*, Leth.), which is so serious a pest of cultivated cotton in this island and elsewhere in the West Indies. The life-history of the insect has been carefully studied, and it has been found that the eggs are deposited in masses in the ground and carefully covered over, where they take seven and a half to nine days to hatch. Destruction of eggs in the field unfortunately does not appear to be practicable, and the campaign against the insect has to take the form of destruction of its native food plants. A special Ordinance has been passed, and between August, 1916, and April, 1917, 1542 silk cotton trees (*Eriodendron anfractuosum*), 11,570 "John Bull" trees (*Thespesia populnea*), and several thousand seedlings have been destroyed. Collection of insects, etc., is also suggested among other measures, as the insect has no natural enemy of importance.

THE question of the precise fertilising value of the basic slags of low solubility which are commonly obtained in the manufacture of steel by the basic open-hearth process has attracted considerable attention during the past few years. The annual production of such slags has been recently computed at 750,000 tons, and with the projected extension of the iron and steel industry this output will steadily increase. The low solubility of the phosphate in these slags is partly attributable to the use of fluorspar in the manufacture, and there is some reason to think that the conventional method of assessing the solubility of slags by means of weak citric acid solution is liable to lead to an undervaluation of their merits in comparison with the more highly soluble slags obtained in the Bessemer process. This view apparently receives considerable support from the results of field trials in Essex, the results of which are contributed by Mr. G. S. Robertson to the January issue of the *Journal of the Board of Agriculture*. At each of three experimental centres in the two years of experiment the hay crops obtained with the fluorspar slags compared very favourably with those obtained by the application of the same weight of phosphoric acid (200 lb. P_2O_5 per acre) in the form of slag of high solubility. Results almost as good were also obtained with equivalent dressings of ground mineral (Gafsa) phosphate. At one centre, however, other plots were added on which the phosphates were applied at one-half the above rate, and the fact that the yields on these plots were fully equal to those obtained with the heavier applications suggests that the latter were too heavy to furnish a decisive test of the citric solubility criterion. It is noteworthy, however, that with the lighter application the fluorspar slag showed a distinct advantage over the more highly soluble slag.

THE Summary Report of the Geological Survey of Canada for 1916 (Ottawa, 1917), a volume of 420 pages, records good war service on the part of the staff, both in the forces in Europe and in the ever-widening field of mineral discovery. Tungsten ores, especially scheelite, are recorded from alluvial deposits on granite in the Yukon plateau, where the climate prevents the concentrates that are secured in one summer from being available until the following winter—that is, until they can be removed on sleighs. A similarly interesting touch is given to operations on the tungsten ores (wolfram and scheelite) of New Brunswick, when it is stated that a mill cannot be remodelled until snow makes haulage of material practicable. Magnesite attracts attention in British Columbia (Bridge River district), where it occurs, with separable veins of chalcedony, in serpentine. The Arctic expedition organised by the Survey reports an extensive copper region on Bathurst inlet. In Banks Peninsula native copper occurs amygdaloidally throughout lavas 350 ft. in thickness.

IT is known from the work of Prof. Barkla that the scattering of ordinary X-rays by light elements agrees well with the view that the number of scattering electrons in an atom is about equal to the atomic number of the element as given by Moseley, and that each electron acts as an independent radiating centre; the scattering of the penetrating γ rays of much shorter wave-length is, however, markedly less than the value to be expected on the simple theory, and the scattered radiation is mostly in the direction of the incident rays. In a recent paper Mr. A. H. Compton (Journ. Wash. Acad. Sci., January 4) attacks this problem from a new point of view. He supposes that the simple theory of scattering no longer holds when the wave-length is comparable with the linear dimensions of the electron. For purposes of calculation he takes the electron to consist of a sphere of positive electricity, each part of

which can scatter independently, and may be capable of rotational motion. On these assumptions he is able to explain the diminution of scattering with decrease of wave-length, and to account for the asymmetry of the scattered rays. Mr. Compton concludes that the electron must have an effective radius of $2 \cdot 3 \times 10^{-10}$ cm.—a value nearly a thousand times greater than the ordinarily accepted radius, calculated from the apparent mass of the electron. He uses in these calculations the data given by Sir Ernest Rutherford and Dr. Andrade on the wave-length of the γ rays, and does not seem to have known of a recent paper by the former in which it is estimated that the wave-length of the most penetrating γ rays from radium is probably less than one-tenth of the lowest value recorded by Rutherford and Andrade. This would make the estimated radius of the electron about one-tenth of the value given by Mr. Compton, but still much larger than the usual value.

In a series of communications to *Terrestrial Magnetism*, Prof. Carl Störmer, of Christiania, has described his photographic determination of auroral heights made in 1913. An account of the earlier communications has already appeared in our columns. The two most recent papers of the series, appearing in March and September, 1917, give an account of Prof. Störmer's theoretical investigations. In a brief historical note he assigns to Goldstein the distinction of having been the first to suggest that an electrical discharge from the sun is the common cause of aurora and magnetic storms. The mathematical problem which Prof. Störmer has set himself treats the earth as an elementary magnet, and as the sole source of a magnetic field traversed by electric corpuscles. A complete solution has not been found even of this simplified problem, but trajectories can be calculated by graphical and numerical integration, and conclusions as to the limiting forms of trajectories can be derived from the general equations. Prof. Störmer accepts for the observed angular radius of the zone of maximum auroral frequency 23°. The values given by his calculations are, for cathode rays 2° to 4°, for β rays 4° to 6°, and for α rays 16° to 19°. The calculated values assume, for the respective rays, such properties as have been actually observed in the laboratory. Prof. Birkeland, the chief supporter of the negative corpuscle theory, suggested, to meet the difficulty, that corpuscles from the sun had velocities very closely approaching that of light. Prof. Störmer thinks it makes fewer claims on the imagination to attribute aurora to α rays, the theory advocated by Vegard. The occasional appearance of aurora far outside the auroral zone is, he admits, a serious difficulty; but he suggests that during magnetic storms the earth may be encircled by a corpuscular ring of large radius, whose modification of the magnetic field may suffice to bring α rays emanating from the sun much nearer the equator than would otherwise be the case. The measurement of auroral streamers is looked to as likely to elucidate at once the penetrating quality of the rays and the constitution and temperature of the upper atmosphere. Further consideration of this aspect of the problem is reserved for a future paper. Prof. Störmer refers to the probable possession by the sun of a magnetic field and an electric charge as considerable complications of the mathematical problem.

The report of the Government Chemist on the work of the Government Laboratory shows that a total number of 258,456 samples were examined during the year ended March 31 last. This is an increase of more than 18,000 compared with the previous year. As might be expected, heavy demands upon the laboratory have been made by the departments specially concerned with war questions. For the Admiralty, the samples analysed included nearly 7000 specimens of metals—an indication of active constructional work by that department. The War Office samples, more than 22,000, were mainly specimens of foodstuffs examined in connection with the control of supplies for the expeditionary forces, together with anæsthetics and other drugs for the medical branch. Numerous questions relating to contraband trading were submitted by the War Trade Department, the Foreign Office, and the Treasury Solicitor. The services of the laboratory have also been extensively utilised by various committees on work arising out of war conditions. It is noted that there has been a very large increase in the use of alcohol in manufacturing operations during the year.

In a paper read before the Swiss Chemical Society, and quoted in *La Nature* for January 26, M. Stettbacher discusses the most powerful explosives which it is possible to obtain. Nitro-glycerine, which is now considered as one of the most violent of explosives, develops but 1580 calories per kilogram. Liquid-air explosives, or oxyliquite, give as much as 2200 calories, since the liquid oxygen combines directly with the carbon and hydrogen. The combinations of hydrocarbons with ozone (ozonide of ethylene and benzene triozonide), although they do not liberate more heat of explosion, are more "brisant," because of their rate of decomposition. It is thus possible to conceive of still higher explosives. A glycerine trichlorate should develop 3000 calories (twice as much as nitro-glycerine), while a mixture of liquid hydrogen and liquid ozone, if it could be realised in practice, would give about 4500 calories. In considering the relative power of explosives other factors than simply the heat generated must be taken into account, the volume of the gaseous products in relation to the original volume of the explosive, and the time factor being important. With liquids there are strict limitations to their practical applications.

A series of "Monographs on Industrial Chemistry" is being edited for Messrs. Longmans and Co. by Sir Edward Thorpe. The volumes are intended to show how essential is the relation of principle to practice. They will afford examples of the application of recent knowledge to modern manufacturing procedure. They are not intended to cover the whole ground of the technology of the matters to which they relate, and will not be concerned with the technical minutiæ of manufacture except in so far as these may be necessary to elucidate some point of principle. Three of the volumes, viz. "The Scientific Use of Coal," Prof. W. A. Bone, "Organic Compounds of Arsenic and Antimony," Prof. G. T. Morgan, and "Edible Oils and Fats," C. A. Mitchell, are announced for appearance in April. "The Zinc Industry," E. A. Smith, and "Colour in Relation to Chemical Constitution," Dr. E. R. Watson, are in the press, and "The Applications of Electrolysis in Chemical Industry," A. J. Hale, "The Natural Organic Colouring Matters," A. G. Perkin and Dr. A. E. Everest, and "Liquid Fuel for Internal Combustion Engines," Sir Boverton Redwood, Bart., and Prof. J. S. S. Brame, are in preparation. In addition, a number of other works have been arranged for.

Messrs. G. Routledge and Sons, Ltd., are about to publish in their "Efficiency Books" "Applied Motion Study: The Efficiency Method Applied to Industrial Preparedness," by Mr. and Mrs. F. B. Gilbreth. Another work for appearance in the same series will be "Wealth from Waste: Elimination of

Waste—A World Problem," by Prof. H. J. Spooner. The same firm also announces "Synthetic Products," by A. R. J. Ramsey and H. C. Weston.

MR. EDWARD ARNOLD announces "Aeronautics in Theory and Experiment," by W. L. Cowley and H. Levy, in which will be chapters on the mathematical theory of fluid motion, the aerofoil, structural parts and controls, strength and construction, the air-screw, and stability.

OUR ASTRONOMICAL COLUMN.

NOVÆ IN THE ANDROMEDA NEBULA.—Including that which appeared in 1885, five novæ in the Great Andromeda Nebula have now been recorded. Two were found by Ritchey on plates taken in 1909, their maximum brightnesses being magnitudes 16·3 and 17·0; these are no longer visible. Another nova, of magnitude 17·5, at a distance of 10′ from the nucleus, was found by Shapley on photographs taken in September last year. The latest discovery was made by Ritchey on a negative taken on October 16, 1917 (Publications Astr. Soc. of the Pacific, December, 1917). This star was of about the 18th magnitude, and the distance from the nucleus approximately 255″ south and 26″ west. On this plate Mr. Shapley's nova was observed to have diminished in brightness by at least two magnitudes in the interval of a month. All the photographs in question were taken with the 60-in. reflector at Mt. Wilson.

NEW VARIABLE STARS.—In Circular No. 201 of the Harvard College Observatory Prof. E. C. Pickering gives details of nineteen new variable stars which have lately been discovered by photographic methods, and of two which were found visually. The brightest images observed range from 8·4 to 13·0, and the faintest from 8·8 to <16. One of the variables is of the Algol type, with a period of 2·89570 days, and two others are Cepheids, with periods of 0·4786 day and 0·365 day. As illustrating the enormous wealth of material available for these investigations, the numbers of photographs examined with reference to the three stars mentioned were 292, 537, and 350 respectively.

Circular No. 202 gives the estimated dates during 1918 of maxima and minima of a large number of long-period variables.

TWO SPECTROSCOPIC BINARIES.—The orbits of the spectroscopic binaries γ Phœnicis and σ Puppis have been investigated by Mr. R. E. Wilson with the aid of photographs taken at Santiago, Chile (Lick Observatory Bulletin, No. 303). γ Phœnicis is a star of magnitude 3·3, Class K5, and has been found to complete a revolution in 193·79 days, the orbit being essentially circular. The semi-amplitude of the velocity-curve is 15·8 km., and the system is receding at the rate of 25·8 km. per sec. γ Phœnicis is the only late-type star at present known to be moving in an orbit of very small eccentricity. σ Puppis is of magnitude 2·99, Class K5, and has a period of 257·8 days. The semi-amplitude is 18·55 km., and the velocity of recession of the system 87·3 km. In this case the eccentricity of the orbit is 0·17.

PROPER MOTION STARS.—In *Astronomische Nachrichten*, No. 4922, Dr. Max Wolf gives particulars of nineteen proper motion stars in the region of the Great Andromeda Nebula, and of five which are near δ Arietis. One of the latter is remarkable as showing the large annual proper motion of 1·74″, in the direction 10°; the star is of the 14th magnitude, and is situated R.A. 3h. 6m. 10s., decl. +18° 23·1′ (1875).

MILITARY AERONAUTICS.

MAJOR BAIRD, in introducing the Air Service Estimates to the House of Commons on February 22, gave an outline of the work which had been done in creating the new Air Force. The works and lands used by the R.F.C. and R.N.A.S. have already been taken over, and co-ordination between the Air Ministry, the War Office, and the Admiralty has been secured by holding weekly conferences of the three staffs. Among the more interesting details of the speech from a scientific point of view are the particulars which Major Baird gave of the activities at the front. After all, the real measure of the success of scientific investigation in aeronautics at home is to be sought in the results achieved in the fighting area. These results were expressed in very concrete form in the speech, and we quote some figures given. In one day on the Western front 127 enemy batteries engaged were under aerial observation, twenty-eight gun-pits were destroyed, eighty more were damaged, and sixty explosions of ammunition were caused. In reconnaissance work nearly 16,000 photographs were taken in one month. Our bombing machines, in short-range operations, dropped an average of 6500 bombs per month, representing a weight of about 120 tons. In addition to these activities, about 150,000 rounds of ammunition per month were used in attacking troops from the air. Such figures as these cannot fail to awaken a sense of the extreme importance of the Air Services in modern warfare; and the first item, viz. the destruction of 127 batteries in a single day, brings home in a very convincing manner the effectiveness of aircraft for the control of artillery. Major Baird warmly commended the work of the Advisory Committee for Aeronautics in furthering the technical side of the subject, and expressed the hope that its valuable labours would add to the efficiency of the new Air Force in the future. The speech met with an enthusiastic reception, which it well deserved, for a more remarkable record of progress in so new a branch of the Services could scarcely be imagined.

La Nature for February 9 contains an interesting article from the pen of Lieut. Jean Abel Lefranc under the title "L'évolution de l'aviation allemande." The author traces the general lines of development of German machines since the beginning of the war. At the commencement of hostilities the most prevalent German type was a heavy biplane of very robust construction as compared with the much lighter machines developed in France. The main tendencies towards improvement in this type have been directed towards a reduction of head resistance by the simplification of the lines of the machine, the adoption of stream-lined fuselages made from three-ply wood, and the elimination of all unnecessary struts and tie-wires leading to the very "clean" design of the present-day machines, but necessitating a somewhat heavy construction. The light single-seaters of the Nieuport type, against which our enemies had to contend, led to the development of the Fokker machine, which in turn gave place to the Albatros D III. of the present time. The failure of the Zeppelins to realise the aims of their inventor led to the necessity of a heavy bombing machine, and the development of this type has resulted in the Gotha of to-day. M. Lefranc points out the various technical improvements made by the Germans as time went on, such as the adoption of appropriate fin surfaces instead of the large dihedral angle and swept-back wings of the earlier machines, and the introduction of balanced controls to obtain flexibility. The importance of standardisation has been clearly recognised, and the result is seen in the three main types now in use, represented by the Albatros D III., a light single-seater

capable of a speed approaching 120 miles per hour; the Aviatik L.V.G., a two-seater with a speed of about 100 miles per hour; and the Gotha, a three-seater bombing machine, with a speed of ninety miles per hour. The general type of construction is still heavier than that of French aeroplanes, requiring a larger engine for a machine of the same performance. M. Lefranc's contributions to *La Nature* have been commented upon several times in these columns, and the present article, like its predecessors, is well worth reading.

By permission of the Air Board, the *Engineer* is publishing full particulars and illustrations of the "Maybach" motor as used by the Germans in their Zeppelin airships, and of the "Mercédès" engine as used in the Gotha aeroplanes. The first article, which appears in the issue for February 22, is descriptive of the Maybach engine, particulars of which were obtained from a study of the motors of the German airship S.L.11, which was brought down at Cuffley in September, 1916, by Lieut. W. L. Robinson. The Mercédès engine described is one of two recovered from the wreck of a Gotha biplane of the pusher type, brought down in Flanders last April. Each of the four Maybach engines carried by the airship had six vertical water-cooled cylinders, giving about 200 b.h.p. at 1200 revolutions. Each engine drove an 18-ft. two-bladed propeller. The circulation of water in the jackets is believed to have been achieved by means of a thermo-syphon system, working in conjunction with a large honeycomb radiator for each engine, and assisted by an accelerator driven from the engine crank-shaft. The exhaust pipe is also water-jacketed, presumably in order to prevent an accidental fire. Drawings of all the more important details are included in the article.

THE ASSOCIATION OF TECHNICAL INSTITUTIONS.

AFTER an interregnum of three years, owing to the war, the Association of Technical Institutions resumed its annual meeting on Friday last, February 22, in the hall of the Worshipful Company of Drapers, in the City of London. The meeting was numerously attended, and was comprised of representatives of the governors, together with the principals of most of the technical institutions of the United Kingdom. Sir Alfred Keogh, G.C.B., who has been president of the association since 1914, was re-elected for 1918. He has now resumed his duties as rector of the Imperial College of Science and Technology, having resigned his position as director of the Army Medical Service. In his presidential address he emphasised the value of science and scientific training, as demonstrated in the great results which, during the course of this deplorable war, have been achieved in the sphere of medical and surgical practice, in relation to the health of the soldier suffering from sickness and wounds, and especially in dealing with diseases which worked such terrible havoc in the military campaigns of past history. The medical profession has rendered splendid service not only in the treatment of disease, but also in its prevention.

Sir Alfred Keogh believes that the nation has come at last to recognise the place that science must occupy in the domain of industry, and also in the sphere of administration, both local and Imperial, which cannot achieve its best and greatest results unless its *personnel* be guided by the spirit and discoveries of science. The new Education Bill of Mr. Fisher marks an immense step forward. The education of the children of the nation, especially in view of the immense sacrifice of the best of our young manhood, has become a question of most serious moment, since they must now assume, at an unusually early age, grave responsibilities, far in advance of their time, in the conduct of affairs. The effective training and the due reward of the teacher are also matters of most grave concern, since, unless these are provided, and the teacher placed beyond anxiety, no education worthy of the name can possibly be ensured.

The training of teachers for technical institutions and for day continuation schools and classes was the subject of a paper read by Principal Watson, of Keighley. Mr. Watson showed how considerable the demand would be, illustrating by the submission of statistical data derived from inquiries made in Keighley, a town of 45,000 inhabitants, from which it appeared that in that town provision must be made for at least 2800 young persons between fourteen and eighteen years of age, requiring at least twenty-five specially trained additional teachers, from which it is deduced that at least 20,000 more teachers will be required of especial character in England and Wales to give adequate effect to the provisions of the Bill with respect to day continuation schools. This is in addition to the extra provision required in the elementary day schools, due to the large number of children who will, under the provisions of the Bill, now be in constant attendance in the schools up to fourteen years of age. The feeling that the education of pupils in the day continuation classes should be based upon liberal lines without vocational bias found strong expression.

Sir Philip Magnus opened a discussion on the best means of continued education, advocating that much advantage is to be gained from a half-time system extending from the age of fourteen until sixteen, with provision for continued education up to eighteen outside the ordinary working hours for at least six hours a week; but the feeling that the association should give unwavering support to the continued education clauses of the Bill as they stand received practically unanimous support. With a view to a more adequate scale of salaries for teachers in technical institutions and with the purpose of securing the services of men of high attainments and ripe technical experience, and to the provision of a suitable scheme of pensions and disablement allowances, it was urged by the association that much larger State grants should be forthcoming in aid of the work of technical institutions.

The regulations for junior technical schools were the subject of much adverse criticism. It was demanded that the course of instruction should be of a liberal character, that it should include a language other than English, that it should not have reference to a special trade or industry, and that the pupil should not be required to signify his intention to adopt a special branch of industry or commerce. The association, in a memorandum on "Education after the War," recently issued, urges that there should be a large increase in the number of scholarships with adequate maintenance grants to enable candidates to proceed to day technical colleges, that the technical departments of universities and technical colleges should be encouraged to undertake research in co-operation with manufacturing firms, and, having regard to the national importance of technical education, should bear a much larger proportion of the cost, and that the Government grants in aid of technical research should be largely increased. In view of the difficulty many institutions have experienced in obtaining necessary supplies, the Ministry of Munitions has empowered the council of the association to endorse applications to which priority will be granted under the order of the hon. secretary. The association extends its warm support to the proposals

set forth on the co-ordination of engineering training at the Conference of Engineers and Educational Associations held at the Institution of Civil Engineers, London, on October 25 last, with the object of securing increased efficiency in the training of apprentice engineers and a wider appreciation of the value in industry of education of university rank.

THE EXPLOITATION OF THE SEA-FISHERIES.

THE sea-fisheries as a source of food was the subject of an interesting series of letters published by the *Times* between February 8 and 18. First of all, Dr. W. S. Bruce directed attention to the abundance of whales and seals in Antarctic seas, and inquired whether Lord Rhondda and "the National Service" had sought advice about all this. Ought not "canning factories and refrigerating vessels to be started immediately in the rich Antarctic whaling grounds"? There are, he stated, whale meat there which "is better to eat and tastes better than beef"; seals and penguins, also an additional meat supply; and "millions and millions of new-laid penguin eggs, larger and better than hen's eggs." Other correspondents supported these remarks, but they did not suggest where the canning factories and refrigerating vessels were to be constructed, nor did they show that it was sounder economics to send fishermen and large vessels to high Antarctic latitudes rather than employ men and small motor-driven vessels to obtain the fish that is plentiful enough just now a few miles away from our own shores.

About the same time Lord Morris and others had an interesting discussion at the Aldwych Club with reference to Newfoundland fisheries and other matters. The remarkable quantities of plaice and soles existing there were mentioned. Letters in the *Times* from Dr. Shipley and Mr. C. Tate Regan rather dulled the alluring picture, and cast doubts on the knowledge of the speakers, by showing that there are *no* plaice or soles in Newfoundland waters. Whether it is better policy to send men and vessels there after the war or to employ them here was not discussed at the Aldwych Club. Before the war British fishermen caught so much sea-fish in British waters that about one-half was exported. The remainder worked out as a ration of about 1½ oz. a day for all persons above five years old. Even then the fishing trades had to organise a "fish as food" campaign to promote the demand.

To the same correspondence remarks were contributed by Capt. Howell, (late) Director of Fisheries for the Punjab, contrasting this country with the United States. We fail because we do not do artificial fish culture on the American scale—fish culture which has been studied here and in Norway as intensely as it is in the United States. Because of this lack of application of science, we are told in the letter of Capt. Howell to the *Times* that "dogfish have ousted plaice as the staple fish of the English Channel." Also, our Governments have lagged behind America in promoting the study of "the pure science of marine biology." America appropriates 8000*l.* a year for that purpose; had any British Government ever voted half that amount? Capt. Howell apparently does not know that, before the war, the Imperial Parliament gave 42,000*l.* a year to the scheme of international exploration of the sea.

Finally, Dr. J. T. Cunningham directed attention to the failure of the Fish Food Committee to promote the general use of pickled herrings as food—a matter about which most people have heard a great deal during the past few months. In further letters Mr. Cecil Harmsworth and Mr. Geo. M. Tabor gave an account of what had been done in this way. Mr. Tabor points out that the stocks are already nearly exhausted. (There were, we believe, some 250,000 barrels of pickled herrings in stock last Easter.) They were offered at "artificially low prices," Mr. Tabor says. These prices were (wholesale):—

Scottish pickled herrings, mean of 1904–13, 24*s.* per barrel; 1913, 36*s.* per barrel; April, 1917, 80*s.* per barrel; September, 1917, 65*s.* per barrel; February 1918, 42*s.*–48*s.* per barrel.

Mr. Tabor's own advertisement (*Fish Trades Gazette*, February 16) points out that Scottish pickled herrings can be bought for 48*s.* per barrel and sold at 4*d.* per lb., making a profit of 30*s.* per barrel, while Norwegian pickled herrings (bought in order to prevent Germany from getting them, Mr. Tabor says) can be had at 29*s.* per barrel and sold at 3*d.* per lb., making a profit of 20*s.* per barrel. The controlled maximum price for pickled herrings is 6*d.* per lb., and that is now also the general minimum price. J. J.

SEISMIC DISTURBANCES CONNECTED WITH THE GUATEMALA EARTHQUAKE.

IN view of the widespread destruction caused by the earthquake in Guatemala, the accompanying notes, written by Dr. Crichton Mitchell, superintendent of Eskdalemuir Observatory, are of interest. We are indebted to the Director of the Meteorological Office for these notes, and are glad to be able to publish them.

From December 25, 1917, until January 4, 1918, a number of seismic disturbances were recorded at Eskdalemuir Observatory by means of the Galitzin seismographs. Some of these were without doubt connected with the disastrous earthquake in Guatemala. But the epicentral distance, about 8500 kilometres, is so great that except in favourable circumstances, it is difficult to detect the primary and secondary waves which form the preliminary phases and from which a determination of epicentral distance is usually obtained. It must also be remembered that the Galitzin instruments are of such high sensitiveness that they record microseismal movements and also local tremors due to wind effects on the building.

The following notes have been drawn up from the seismograms for the period referred to above:—

December 25, 1917.—From 11h. 15m. until 20h. wind effects on the record make it impossible to say whether there was any true seismic effect or not. Otherwise there was no disturbance recorded.

December 26, 1917.—After 5h. a faint disturbance was recorded. Its maximum on the E.-W. instrument occurred at 5h. 15m. 47s.; its period was 19s., and the amplitude was 1·5 μ. These were long waves due to some distant earthquake, but no preliminary phases were noticeable. Similar waves were recorded on the E.-W. instrument from 6h. 4m. to 6h. 22m.

Between 9h. and 10h. the long-wave phase of a disturbance, the preliminary phases of which were too feeble to be identified, was recorded. The first noticeable portion consisted of a slight impulse in a direction nearly from S.W. to N.E. at 9h. 26m. 11s. Fairly well marked long waves began at 9h. 28m. 55s., with a period of 18s. and a maximum amplitude of 10·6 μ at 9h. 29m. 28s. The end of this slight disturbance came about 15m. afterwards.

Another series of long waves of low amplitude occurred from 14h. 5m. to 14h. 15m.

December 27, 1917.—A slight disturbance with no distinctly marked phases began at 7h. 52m., and lasted until 8h. 8m.

December 28, 1917.—A large disturbance was re-

corded between 21h. and 22h. The timings of the preliminary phases are somewhat doubtful, first, because the motions connected with them were very slight; secondly, because wind and microseismic effects masked the true earthquake effect. The following may, however, be taken as approximately correct:—Primary, 21h. 24m. 44s.; secondary, 21h. 34m. 4s. The beginning of the long-wave phase was about 21h. 49m. These times correspond with an earthquake at the distance of Guatemala. The following maxima were recorded:—

	Time	Period	Amplitude
N.-S. component	21h. 57m. 33s.	19s.	18·5 μ
E.-W. component	21h. 58m. 13s.	18s.	17·1 μ

The largest vertical motions occurred about the same time. The displacements due to the horizontal waves were in the S.W.-N.E. direction. The disturbance continued until about 24h.

December 29, 1917.—Another large disturbance occurred on the evening of this day. Very unfortunately, the light failed about an hour before the earthquake began, a minute particle of soot having blocked the acetylene jet. In consequence, the photographic record for the horizontal components is too faint to be read with accuracy. The vertical instrument gave a very fine record, however, and from it the following times are taken:—Primary, 23h. 2m. 43s.; secondary, 23h. 12m. 39s. The maximum displacements were at 23h. 37½m., and had a period of 21s. The disturbance did not die down until 1h. 30m. on December 30.

December 30, 1917.—A faint disturbance was recorded from 16h. 41m. until 17h. 9m.

January 1, 1918.—From about 0h. until 15h. a somewhat unusual record was obtained from the horizontal instruments. Ordinarily, on a seismically quiet day, the trace shows nothing but the regular microseisms. But, superposed on these, there was, during the interval referred to, an almost continual movement of an irregular kind, due most probably to a large number of minor shocks at some distant epicentre.

January 3, 1918.—From 0h. 19m. to 0h. 42m. a faint disturbance occurred. From 14h. 0m. to 14h. 21m. a slight disturbance, including two groups of long waves, was recorded. The first group had a period averaging 26s., the second averaging 20s.

Wind effects obscured the seismogram about midnight, but the trace shows signs of faint disturbance.

January 4, 1918.—A larger disturbance was noticed four hours later. The primary wave occurred at 4h. 44m. 37s., the secondary at 4h. 54m. 38s., and the long-wave phase began about 5h. 9m. These timings indicate an epicentre at the distance of Guatemala. The maximum displacement occurred at 5h. 19m. on the E.-W. instrument, its period being 20s., and the amplitude 4·2 μ.

At 16h. 30m. a slight, indefinitely marked disturbance began and lasted for nearly an hour.

All the above times are G.M.T.

THE PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION.

THE seventieth meeting of the American Association for the Advancement of Science was held in Pittsburgh, Pennsylvania, December 28, 1917–January 3, 1918. The total registration at the office of the permanent secretary was 692.

The impressive keynote of the whole meeting was war preparation and efficiency. This was borne out not only in a number of symposia devoted to specific war topics, but also in other discussions, and in other papers, the titles of which would not necessarily lead one to expect a development along the line of war preparation.

The opening general session of the association was held on Friday night, December 28, in the lecture hall of the Carnegie Institution. The president of the association, Prof. T. W. Richards, of Harvard University, was absent, and Dr. G. H. Perkins, of the University of Vermont, senior vice-president, presided. Mr. H. M. Irons, city attorney of Pittsburgh, gave an address of welcome on behalf of the mayor of Pittsburgh, to which Dr. Perkins replied.

Dr. C. R. Van Hise, retiring president of the association, in his address on "Some Economic Aspects of the World War," set the note for the entire meeting. Certain special items on the programme of the week may be especially mentioned on account of their war bearing.

Section C held a symposium on "Education in Chemical Engineering." Section M held an important symposium on "Factors Concerned in an Increased Agricultural Production." Section I listened to a paper by the Hon. John Barrett on "The War and the New Pan-America," and before the same section Mr. H. E. Coffin, President of the Aircraft Board at Washington, spoke on the subject of "General Standardisation." Section B held a general interest session on the subject of "Relationship of Physics to the War." Section G, with the Botanical Society of America and the American Phytopathological Society, held a joint session on "War Problems in Botany." Dr. Vernon L. Kellogg, formerly of the Belgium Relief Commission, and now with Mr. Hoover's board in Washington, gave an exceedingly strong address before the Entomological Society of America on "The Biological Aspects of the War." Section I held a special symposium on "War Problems." Section F held a symposium on "Contributions of Zoology to Human Welfare," in which many war problems were discussed. Section K held a very important symposium on the subject of "Medical Problems of the War." This symposium included an address by Lieut. George Loewy, of the French Army, on "The Treatment of War Wounds by the Carrel Method," which was illustrated by moving pictures. The School Garden Association of America held a symposium on "Organisation of War Gardens." The Association of Economic Entomologists discussed the two following topics at length: "Insects and Camp Sanitation" and "How the Entomologist can Assist in Increasing Food Production." The Botanical Society of America and the American Phytopathological Society held a symposium on "Phytopathology in Relation to War Service."

It was decided to hold the next meeting of the association in Boston, Massachusetts, the meeting to begin on Friday, December 27, 1918. The following officers were elected:—*President*, J. M. Coulter, of the University of Chicago; *Presidents of Sections*: A, G. D. Burkhoff, Harvard University; B, G. T. Hull, Dartmouth College; C, Alex. Smith, Columbia University; D, I. N. Hollis, Worcester Polytechnic Institute; E, D. White, U.S. Geological Survey, Washington, D.C.; F, W. Patten, Dartmouth College; G, A. F. Blakeslee, Cold Spring Harbour; H, (no election); I, J. Barrett, Washington; K, F. S. Lee, Columbia University; L, S. A. Courtis, Detroit, Mich.; M, H. P. Armsby, Pennsylvania State College.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The council of the University and the Principal (Sir Oliver Lodge) have issued, for presentation at the annual meeting of the Court of Governors, their reports for the session 1916–17. The war has reduced the total number of students to about 63 per cent. of the normal. The diminution affects all facul-

ties, but the chief sufferers have been the faculties of commerce and science, which show reductions to 33 and 37 per cent. respectively of the figures for 1913–14, whereas the corresponding strengths of the faculties of arts and medicine are respectively 69 and 81 per cent. It is noteworthy that in the faculties of science, arts, and commerce, taken together, women constitute 68 per cent., and in the faculty of medicine 41 per cent. The reports show that the University is taking its share in the application of science to war purposes, and that steps are being taken to bring the faculty of science into closer contact with the industrial world. In the concluding part of his report the Principal deals with after-war conditions. He says:—"One of the many problems which must press for attention after the war is the closer linking of science with industry—in other words, a more determined attack on practical problems and an application to useful purposes of what is known. But it will behove us in the University vividly to remember that pure science must precede applications of science, and that unless pure science is cultivated in universities it is not likely to be pursued with adequate attention anywhere. . . . We must have faith that all real knowledge, as soon as it becomes familiar, can be made useful by those who have opportunity to apply it. For it is impossible for a university to pursue knowledge for its own sake with adequate resources unless the community recognises this as its duty, and has faith enough in the ultimate outcome to be willing to make provision, even lavish provision, for its pursuit without expectation of an immediate pecuniary result. . . . Nevertheless, demands are likely to be made upon us, as now during the war, for specific research into problems arising in design and manufacture. Up to a point this is quite proper and to be encouraged, for such problems are often informing, and their solution may lead to fresh developments. Science and its applications interact on each other, and a sharp dividing line is neither feasible nor wanted, but as a rule universities should specially cultivate pure learning of every kind."

LONDON.—The following doctorate in science has been conferred by the Senate:—*D.Sc. in Botany*, Mr. Cyril West, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "A Contribution to the Study of the Marattiaceæ."

The Senate has appointed the following fellows of University College and King's College respectively:—*University College:* Mr. Wedgwood Benn, Mrs. Elsie Blackman, Dr. Harriette Chick, Dr. E. M. Cowell, Dr. C. A. Lovatt Evans, Dr. David Heron, Mr. W. H. Lister, Mr. E. K. Martin, and Mr. E. T. Paris. *King's College:* Prof. Arthur Dendy, Mr. F. Lydall, and Mr. L. J. Robertson.

The report of the Military Education Committee of the University of London for 1917 has been presented to the Senate. The number of commissions in the Army and Navy granted to cadets and ex-cadets of the University O.T.C. up to the end of 1917 was 3618, and, in addition, 308 graduates and students of the University obtained commissions in the early months of the war upon the recommendation of the committee, making a total of 3926 officers. Of the 3618 former cadets of the University of London O.T.C. who have proceeded to commissions, 440, whose names are recorded in the report, have fallen in the war, and 508 have gained distinctions, including:—V.C., 3; M.V.O., 1; D.S.O., 15; Military Cross, 292 (including 3 with two bars and 7 with one bar); Distinguished Service Cross, 3; Croix de Guerre, 8; Médaille Militaire, 1; other foreign Orders, etc., 7; mentioned in despatches, 291 (mentioned thrice, 4; twice, 21). The number of distinctions gained by former cadets is 663. The strength of the University O.T.C., as given in the report, shows some decrease on the strength in the previous year, due mainly to the reduction of the age for military service in the Army from nineteen to eighteen. In consequence of this, the committee states, "the resources of the University, which were so freely drawn upon in the earlier years of the war for the education and military training of future Army officers, cannot under present conditions be fully used for the same purpose." Particulars are given in the report as to the conditions at present in force for enrolment in the University O.T.C.

MANCHESTER.—The University has recently benefited by the foundation of new scholarships and prizes. Amongst these are industrial research scholarships intended to enable graduates and others to obtain training in the methods of research with the object of rendering them better qualified to enter industry. The first of these scholarships was instituted in organic chemical research by Messrs. Levinstein, Ltd. The firm of Messrs. Simon-Carves, Ltd., has now instituted a second scholarship in inorganic chemical research. The scholarships are of the value of 100*l.* per annum, tenable in the first instance for one year. The work of the scholar is determined by the professor concerned with the subject of research. During the tenure of the scholarship the scholar is required to devote his whole time to research.

A prize has been founded by Mr. Ernest A. Knight, of Knutsford, to be known as the Knight prize and intended for the encouragement of the study of the part played by psychological factors in the development of the symptoms of mental disturbance. The prize will be of the value of 50*l.*, and offered annually. It will be open to the competition of persons who have entered upon the course for the diploma in psychological medicine of the University.

Under the will of the late Mrs. Selina Mary Bright a scholarship in physical science has been instituted, to be called the Samuel Bright scholarship. The course of study pursued by the scholar is not to include vivisection. The regulations for the scholarship are not yet finally approved, but will be published shortly.

MR. FISHER'S Education (No. 2) Bill to make further provision with respect to education in England and Wales, and for purposes connected therewith, was presented formally to the House of Commons on Monday, February 25, and was read a first time.

PROF. D. DRUMMOND has been elected president of the University of Durham College of Medicine in succession to the late Sir G. H. Philipson, and the Chancellor has appointed him pro-Vice-Chancellor of the University.

THE Morison lectures of the Royal College of Physicians of Edinburgh will be delivered on March 4, 6, and 8 by Dr. J. J. Graham Brown, who will take as his subject certain disorders of the sympathetic and parasympathetic systems.

IT is reported in the *Revue scientifique*, on the authority of the *Temps*, that the excavation of the ruins of the University of Louvain, destroyed by the Germans, has been commenced under the direction of a committee including MM. Oehler, Bersy, Lemaire, and Vingerhoedts. The excavation of the ruins of the library, in which the historic books and manuscripts were housed, has led to the recovery of nothing of value. It is feared that the bibliographical treasures are irretrievably lost.

BY the will of Sir Edgar Sebright, his estate is charged with "such a sum as will produce a clear 315*l.* a year and expenses for the foundation of a scholarship at Eton College for a deserving scholar or Oppidan

for the usual three years' course at Oxford or Cambridge University."—Sir Edward Wood, of Leicester, who died on September 27 last, left 2000*l*. for a Sir Edward Wood scholarship at the Wyggeston Hospital Schools for sons of parents who require assistance in giving their sons a higher education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 14.—Sir J. J. Thomson, president, in the chair.—Prof. E. W. **MacBride**: The artificial production of Echinoderm larvæ with two water-vascular systems, and also of larvæ devoid of a water-vascular system. In Echinoderm larvæ the change from bilateral to radial symmetry is due to a series of changes which are ushered in by the appearance of a small bud, termed the hydrocœle, on the left side of the larvæ. This bud is the rudiment of the water-vascular system of the adult. A number of instances have been recorded where, in an isolated specimen, a similar bud has appeared on the right side also, and the whole later history of the larvæ has been altered. The present communication describes a method for inducing the formation of a second hydrocœle. By exposing the larvæ to the action of hypertonic water at a certain critical period of their development, and by removing them afterwards to extremely favourable surroundings, in so far as concerns both food and space, it is possible to secure that a certain percentage of them will possess two hydrocœles. The development of the second hydrocœle may begin earlier or later. If it begin earlier the organs found in the normal larvæ on the right side (pedicellariæ) will not be formed, but if it begin later one or more of these organs may be formed. If larvæ be starved for the first week of their existence and then transferred to good conditions as to food and space, the formation of both hydrocœle and pedicellariæ will be inhibited, and larvæ perfectly bilaterally symmetrical will be produced which are provided on each side with a group of pointed spines in place of both hydrocœle and pedicellariæ. From this observation it seems to follow that the formation of pedicellariæ is dependent on the presence of a hydrocœle bud, so that this bud tends to induce the formation of pedicellariæ on the opposite side of the larvæ, and to inhibit their formation on the same side as itself. The formation of a hydrocœle bud on the right side involves profound modifications of the surrounding tissues. These tissues are forced to pursue a course of development totally foreign to anything that has been normal in the history of the race. In conclusion, the bearing of the facts adduced on the nature of the laws governing the building up of the bodies of embryos and larvæ is discussed.—Prof. J. B. **Farmer**: The quantitative differences in the water-conductivity of the wood in trees and shrubs. The paper deals with the efficiency of the wood regarded from the viewpoint of water-conductivity. About sixty species of plants, chiefly trees and shrubs, have been investigated. The method adopted consists in determining the amount of water passing in fifteen minutes, delivered at a head of 30 cm. of mercury through each square centimetre of wood of 15 cm. in length. The results show that wide differences exist between different species, but that for a given species there is commonly an ascertainable mean. Evergreens as a class are characterised by wood of low conductivity with often small absolute fluctuation. Deciduous adult trees and shrubs always possess wood of relatively high conductivity, but the sapling trees and stool shoots of coppiced woods exhibit low conductivity in their wood, even when that of the adult shoots is high. The results are of significance in throwing light on an aspect of xerophily and of transpiration which has hitherto been disregarded. It is also shown that the dying back of the leaders in some trees (*e.g.* ash) is correlated with the character of their wood. The sap wood of deciduous trees commonly fills up with water during the early autumn, and grounds are shown for observing caution in fitting conclusions reached in other climates to the circumstances that obtain in the British Isles. This matter is of some importance in its bearing on the conditions that affect the seasoning of timber.—Capt. M. **Greenwood**: The efficiency of muscular work. It is shown that the relation between total heat production, body mass, and external work can be expressed with sufficient accuracy for interpolation by a function of the first degree, the constants of which have been determined from the data by the method of multiple regression. The method is illustrated upon

body mass is constant, the relation is $H = aW + b$, H being total heat production, W the thermal equivalent of the work, a a constant, and b a variable parameter dependent upon the speed of work performance. The parameters are calculated for the data of Benedict and Cathcart. It is pointed out that the relation necessarily involves an increase of efficiency with amount of work when efficiency is defined as W/H or as $W/(H-h)$, h being the "basal" heat production, and that this increase may be without biological significance. Reasons are given for doubting whether the general relation between heat production and muscular efficiency can be safely inferred from existing series of observations, and economy of thermogenesis is discussed.

Linnean Society, February 7.—Sir David Prain, president, in the chair.—Dr. B. Daydon **Jackson**: (1) The "Panphyton siculum" of Francesco Cupani (1657–1710). A few copies, none of which were complete, were issued in 1713 by Cupani's patron, the Prince Della Cattolica, the copy in the library of the Jesuit Fathers at Palermo being the nearest complete, and therefore cited by Gussone in his "Prodromus" and "Synopsis"; it consists of three volumes with about 700 plates, without text; the copy in the Linnean Society's library has only 196 plates, two of which are in duplicate. (2) "L'Histoire et pourtrait des plantes," Lyon, 1561. The volume belonged to Linné, and a pencil note on the title-page by Smith refers to an entry in Haller's "Bibliotheca botanica," vol. i., p. 318 which proves to be copied from Adanson's "Familles des plantes," vol. i., p. 6, where the book is described from Jussieu's library, but Jussieu's copy is given as published at Rouen in 1555, and attributed to Du Gort; the brothers Jean and Robert Du Gort were printers at Rouen at that time, and probably drew up the volume from the Lyons issue of Fuchs's "Historia stirpium" of 1551, for nineteen of the cuts are identical in both books, with eight not yet traced.—H. B. **Guppy**: Plant-distribution from the point of view of an idealist. The paper began with an appeal for the mutual co-operation of the supporters of the original Darwinian theory of evolution and of the later hypothesis of mutation advanced by De Vries. If the view is correct that in the history of the Angiosperms we have two main eras—the era of the rise of the great families and the era of their later differentiation—the mutationist would find his most fitting field of work in the older era and the orthodox Darwinian in the later one. It is held that the distinction between the two schools is in degree rather than in kind, and that the age that witnessed the rise of the great families and the age that witnessed their later differentiation are things apart. Distribution is primarily an affair of the larger groups; and the problems that centre around the rise of the great families raise issues that cannot be stated in

terms of genera and species. Postulating the original existence of world-ranging generalised family types during an era of uniform conditions, it is argued that the differentiation of these primitive types was in response to the progressive differentiation of their conditions. The distribution of families is treated statistically, and it is shown that whilst they largely ignore the cleavage of the land into two great masses, diverging from the north, they respond in marked degree to the differentiation of the climatic zones. The paper ends with the statistical treatment of the larger groups behind the families, and it is shown that whilst the Dicotyledons display a much greater tendency to detachment from the tropics than do the Monocotyledons, the Sympetalæ stand foremost in this respect amongst all the primary groups.

Physical Society, February 8.—Prof. C. V. Boys, president, in the chair.—Prof. C. V. **Boys**: A recording thermometer. This instrument was designed and constructed to go into the case of a regulator clock. The thermometric element consists of a rod of ebonite within a glass tube. The differential expansion is determined by a pair of levers giving a movement of 1 in. for 10° F. The drum carries an ordinary barometer chart, and is driven at such a speed that a two-hour interval of ⅛ in. is passed in twenty-four hours. The drum is driven by friction by means of a cord from below the driving weight of the clock by an $e^{\mu\theta}$ arrangement, in virtue of which when the clockweight descends the drum turns, but when the clock is wound the drum remains at rest. The instrument is designed with a view to easy construction and accuracy. It is extremely rigid, and much more magnification might be used. An alternative design on the same lines to go into a recording barograph is also given.—S. D. **Chalmers**: The primary monochromatic aberrations of a centred optical system. The paper describes approximate methods of treatment of the first-order aberrations of a centred optical system. Two methods are used, one primarily suited to the case where the separation of the surface is small, and the other more suited for use where the separations vitally affect the design. The aberrational defects are expressed as lateral aberrations—*i.e.* as defects measured in the focal plane of the system. The procedure adopted is to express the aberrational defect of a single surface in terms of the constants of the surface, and the perpendicular distance of the ray considered from the centre of curvature of the surface. The value of this perpendicular can be expressed in terms of the co-ordinates of the ray in any chosen medium, and thus the aberration due to each surface can be expressed in terms of the co-ordinates of the chosen ray, in such a way that the aberrations of the individual surfaces can be summed.

Optical Society, February 14.—Prof. F. J. Cheshire, president, in the chair.—T. Y. **Baker**: Reflecting prisms. The author advocated the use of prisms in place of mirrors as being easier to mount and as requiring, in many cases, no silvering. A series of suitable designs for certain double reflecting prisms, in which the light is made to deviate by a fixed amount, was shown for angles 0°, 15°, 30° . . . 90°, the form in each case being that which gave maximum aperture to the prism. A special form of triple reflecting prism, with angles of 30°, 30°, and 120°, was described, which the author considered would be much more suitable for the horizon glass of a sextant than the customary plane mirror, as it would enable the telescope to be placed close up to the prism without any danger of cutting off light between the two mirrors. To avoid this happening in an ordinary sextant, the horizon glass has to be set at an angle of 75° to the axis of the telescope, and the latter set well back, so that the angular aperture is equivalent to 15°, whereas with the prism described the aperture would be about 50°, and angles could be measured up to 170°, in place of the maximum range of 150° in an ordinary sextant.

Royal Meteorological Society, February 20.—Sir Napier Shaw, president, in the chair.—F. A. **Bellamy**: The barometer record at the Radcliffe Observatory, Oxford, with special reference to Prof. Turner's suggested discontinuities. Prof. Turner has in several papers to the Royal Meteorological Society claimed that meteorological history is divisible into "chapters" of an average length of six and a half years each, and has assigned the dates at which a new "chapter" opens (when there are abrupt discontinuities in meteorological phenomena) with considerable precision for the last two centuries. The evidence has hitherto been based upon the monthly mean values of rainfall and temperature, and he has shown that these monthly means differ systematically in the "even" chapters as compared with the "odd." To examine whether such systematic differences extended to periods shorter than one month, Mr. Bellamy has analysed a series of sixty-two years' daily barometer records made at the Radcliffe Observatory, Oxford, many of them made by himself while there in 1891–92. He concludes from his analysis that for periods from one to six months there is a decided difference in the even and odd chapters for atmospheric pressure, even for one station, as there has been shown for rainfall and temperature from many stations in the world, and that the matter of discontinuities is supported.—Dr. C. **Chree**: The diurnal variation of barometric pressure at seven British observatories, 1871–82. The diurnal variation of atmospheric pressure, as of any other element, can be analysed in Fourier terms or "waves" of periods twenty-four, twelve, and eight hours. In the case of the mean diurnal variation from all months of the year combined, the twelve-hour wave appears of a very dominant character, the amplitude being nearly the same for all stations in the same latitude, and the phase referred to local mean time being everywhere nearly the same. The twenty-four-hour wave, on the other hand, is very variable, and the eight-hour wave small compared with the twelve-hour wave. Taking the seven stations, Valencia, Armagh, Glasgow, Aberdeen, Stonyhurst, Falmouth, and Kew, it is pointed out that the comparative unimportance of the eight-hour wave in the mean diurnal inequality for the year arises in great measure from the large difference that presents itself between the phase angles in two different seasons of the year. In individual months the eight-hour wave, though considerably smaller than the twelve-hour wave, is far from negligible, and the phenomena presented by the eight-hour wave at the seven British stations exhibit almost as close a similarity as those presented by the twelve-hour wave. The paper also considers a theory as to the nature of the twelve-hour wave recently advanced by Dr. G. C. Simpson.

MANCHESTER.

Literary and Philosophical Society, February 19.—Mr. W. Thomson, president, in the chair.—Dr. J. Stuart **Thomson**: The occurrence of *Cavernularia Lütkenii*, Köll, in the seas of Natal.—L. Stanley **Jast**: The necessity for a technical library for Manchester and district. Manchester should lead in that provision of technical libraries which must form a not inconsiderable part of our equipment for shouldering our due share of the commerce of the world after the war.

EDINBURGH.

Royal Society, February 4.—Dr. John Horne in the chair.—Dr. J. Stuart **Thomson**: The morphology of the Prosencephalon of Spinax as a type of Elasmobranch

fore-brain. The author describes the nerve-cell areas and the fibre tracts. The cell-areas definitely located are:—Tuberculum olfactorium, corpus striatum, formatio pallialis, primordium hippocampi, and the para-terminal body. The author describes twelve fibre-tracts, but he could find nothing to indicate the existence of a corpus callosum in Spinax.—Dr. J. M. **Thompson**: The anatomy and affinity of certain rare and primitive ferns. The genera Jamesonia, Llavea, and Trismeria were specially considered. The investigation seemed to show that the structural features of Jamesonia are relatively primitive, and the sporangial characters in particular are valuable guides in the consideration of relationship. The features of the plant are distinctive, and justify its maintenance as a distinct genus, with a high spore output and a Schizæoid origin. In the case of Llavea the anatomical state was considered transitional, but suggestive of primitive relationships, and the sporangia seemed to be of an advanced type in which a large spore output had not persisted. This plant was held to be a distinct genus. In Trismeria the anatomical and sporangial characters were considered more advanced, and comparison showed that the plant is in reality a Gymnogramme of Ceropterid type. With Jamesonia and Llavea it seemed to belong to a laxly associated group of "Acrostichoid" derivatives of some Schizæoid source. Among the comparative points raised was the marked variability of spore size seen in certain of the ferns considered. This variation in ferns of more or less clear Schizæoid source was considered suggestive of the origin of heterospory.—Miss M. I. H. **Ferguson**: A further study of the diets of labouring-class families in Glasgow in war-time. (This was a continuation of previous studies communicated to the society in 1916; see NATURE, vol. xcviii., p. 463.) One general result was that in spite of the increased cost of foodstuffs there was practically no change in the diets of February, 1917, and November, 1917. There was a marked increase in the consumption of potatoes in November as compared with their consumption in February, but this was not apparently accompanied by decreased consumption of flour. It appeared that no less than per cent. of the energy was obtained from the rationed food, although in 1915–16 this yielded only 75 per cent. It is of interest to know that in certain families where the father was on military service the diet was more adequate than when he was at home.

DUBLIN.

Royal Irish Academy, February 11.—Mr. T. J. Westropp, vice-president, in the chair.—J. A. **McClelland** and the Rev. C. J. **Power**: Electrification by friction. The rate of production of charge on various metals when pressed against a rotating disc of tightly stretched linen or silk has been measured under various conditions. Results are given showing how the rate of production depends on the speed of the disc, the pressure between the rubbing surfaces, the condition of the metal surface, the temperature, and the humidity. The last section of the paper deals with experiments carried out in air at very low pressures.—G. H. **Carpenter** and F. J. S. **Pollard**: The presence of lateral spiracles in the larva of Hypoderma. The authors describe six pairs of minute lateral spiracles in the fourth-stage larva of *Hypoderma bovis* and *H. lineatum*. Each spiracle is open at the surface of the cuticle, but study of transverse sections shows that the vestigial air-tube connected with it is plugged by a core of solid chitin. These plugged tubes become continuous with branches of the tracheal system in which the normal spirally thickened lining can be clearly recognised. The anterior spiracles in Hypoderma closely resemble these lateral spiracles, and the forward ends of the tracheal trunks leading to them are also plugged with chitinous cores. The presence of vestigial lateral spiracles in specialised parasitic larvæ, like the warble-maggots, is remarkable. No description of such structures in any muscoid larva seems to have been published hitherto, though Pantel mentioned their existence in tachinine maggots in 1901.

PARIS.

Academy of Sciences, January 21.—M. Léon Guignard in the chair.—L. **Maquenne** and E. **Demoussy**: The influence of metallic salts on germination in presence of calcium. The presence of any salt at a concentration approaching a harmful dose in pure water reduces the favourable action upon germination which calcium salts exert alone. The effect is particularly marked with copper sulphate, which, in amounts 0·01 to 0·025 mgr. per seed, has no unfavourable action alone, whilst it reduces the root length by a quarter to a third in presence of 0·05 mgr. of calcium sulphate.—C. **Richet**, P. **Brodin**, and F. **Saint-Girons**: Some modifications in the treatment of pulmonary tuberculosis by antiseptic inhalations. Experiments were made with creosote, camphor, phenol, gomenol, iodoform, and terebene, dissolved in vaseline oil, the dose inhaled being controlled by the temperature of the oil. The same antiseptic was never inhaled on two consecutive occasions. Creosote and gomenol gave the best results, inhaled twice a day for one hour each time. There was a marked improvement after two months' treatment in severe cases, increase of weight and muscular strength, and reduction of expectoration and cough.—A. de **Gramont**: Researches on the line spectrum of titanium and its applications.—W. **Kilian**: The coalfield in the neighbourhood of Saint-Michel-de-Maurienne (Savoy). The layer of schist, rich in anthracite, has a flora characteristic of levels between the middle Westphalian and the Stephanian, the former predominating. There are numerous seams of anthracite, averaging one to two metres in thickness, and it is estimated that as a minimum there are five million tons available with horizontal adits.—R. **Garnier**: The irregular singularities of linear differential equations. —J. C. **Solá**: The study of stellar currents. Photographs were taken at intervals of from two to six years, and selected portions of the plates, sixty-two altogether, studied stereoscopically, and the direction of the current was determined for each. The results are given in tabular form.—A. **Véronnet**: The law of densities of a gaseous mass and internal temperatures of the sun. —L. **Bloch**: The theories of gravitation.—H. **Chaumat**: A phenomenon of super-voltage in a continuous-current circuit deprived of self-induction.—C. **Matignon** and F. **Meyer**: Invariant equilibria in the ternary system: water, sodium sulphate, ammonium sulphate.—L. **Gentil** and L. **Joleaud**: The great tectonic zones of Tunis.—A. **Mailhe**: New preparation of the fatty nitriles by catalysis. The method recently described for the catalytic preparation of aromatic nitriles has been extended to the fatty series, and details are given for isovaleronitrile, butyronitrile, and propionitrile. The reaction is a general one.—G. **Reboul**: The relation between variations of the barometer and those of the wind at the ground level: application to prediction. —R. **Leriche** and A. **Policard**: The histological mechanism of the formation of new bone during osseous regeneration in man. New bone substance appears to be formed by a process analogous with that described by Korff for dentine and some types of bone. With some reserves for certain points of detail and terminology, it would appear that Korff's conception is more in accord with the facts than the classical theory.—A. **Durand**: The sense of smell. This depends, according to the author, upon the following conditions: the

presence in the air of centres (*ions odorants*) capable of facilitating the condensation of atmospheric moisture, a suitable hygrometric state, and cooling of the air current produced by inspiration.—J. E. **Abelous** and J. **Aloy**: The necessity for a hydrogen acceptor and an oxygen acceptor for the manifestation of the process of oxido-reduction in organic liquids of animal and vegetable origin.—M. **Marage**: Contribution to the study of war *commotions*. Defining *commotion* as the lesions produced in a point of the nervous system either central or peripheral, it is shown that this arises from large pressures acting for very short periods of time on the whole of the body surface, and transmitted by the liquids of the organism to the cortical substance of the brain contained in an indeformable chamber, the skull.

BOOKS RECEIVED.

Transmission Gears, Mechanical, Electric, and Hydraulic, for Land and Marine Purposes. By E. Butler. Pp. xii+164. (London: C. Griffin and Co., Ltd.) 8*s*. 6*d*. net.

The Exploitation of Plants. By various writers, edited by Prof. F. W. Oliver. Pp. vii+170. (London and Toronto: J. M. Dent and Sons, Ltd.) 2*s*. 6*d*. net.

The Kiln Drying of Lumber. By H. D. Tiemann. Pp. ix+316. (Philadelphia and London: J. B. Lippincott Co.) 18*s*. net.

Field Sanitation. By C. G. Moor and E. E. Cooper and others. Pp. viii+220. (London: Baillière, Tindall, and Co.) 2*s*. 6*d*. net.

Western Live-Stock Management. Edited by Prof. E. L. Potter. Pp. xiv+462. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s*. net.

A Manual of Physics: Theoretical and Practical, for Medical Students. By Prof. H. C. H. Candy. Second edition. Pp. viii+451. (London: Cassell and Co., Ltd.) 7*s*. 6*d*. net.

Lyon's Medical Jurisprudence for India, with Illustrative Cases. By Lt.-Col. L. A. Waddell. Sixth edition. Pp. xiii+783. (Calcutta and Simla: Thacker, Spink, and Co.; London: W. Thacker and Co.) 28*s*. net.

Directions for a Practical Course in Chemical Physiology. By Dr. W. Cramer. Third edition. Pp. viii+119. (London: Longmans and Co.) 3*s*. net.

The Baby. By Dr. S. Seekings. Pp. 63. (London: S.P.C.K.) 9*d*.

The Improvement of the Gregorian Calendar. By A. Philip. Pp. 30. (London: G. Routledge and Sons, Ltd.) 1*s*. 6*d*. net.

A Dictionary of Aircraft. By W. E. Dommett. Pp. 52. (London: Electrical Press, Ltd.) 2*s*. net.

Experiments in Psychical Research at Leland Stanford Junior University. By J. E. Coover. Pp. xxiv+641. (California: Stanford University.) 3.50 dollars.

Infinitesimal Calculus. By Prof. F. S. Carey. Section II. Pp. x+352+iv. (London: Longmans and Co.) 10*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 28.

ROYAL SOCIETY, at 4.30.—Scattering of Light by Dust-free Air, with Artificial Reproduction of the Blue Sky. Preliminary Note: The Hon. R. J. Strutt.—The Lommel-Weber Ω Function and its Application to the Problem of Electric Waves on a Thin Anchor Ring: Dr. J. R. Airey.—Investigations on Textile Fibres: W. Harrison.—Critical Loading of Struts and Structure: W. L. Cowley and H. Levy.

FRIDAY, MARCH 1.

ROYAL INSTITUTION, at 5.30.—The Modern Dye-stuff Industry: Prof. A. G. Green.

SATURDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

MONDAY, MARCH 4.

ARISTOTELIAN SOCIETY, at 8.—*Symposium*: Does the Knowing Mind Contribute to the Structure of the Object Known? Prof. G. Dawes Hicks and Dr. H. Wildon Carr.

ROYAL SOCIETY OF ARTS, at 4.30.—The Effect of the War on the Economic Condition of the United Kingdom: E. Crammond.

TUESDAY, MARCH 5.

ROYAL INSTITUTION, at 3.—The National Physical Laboratory: Sir R. T. Glazebrook.

ZOOLOGICAL SOCIETY, at 5.30.—The External Characters of the Lemurs and Tarsius: R. I. Pocock.—A Classification of the Pyralidæ, Subfamily Hypsotropinæ: Sir George F. Hampson.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Modern Developments in Gasworks Construction and Practice: A. Meade.

ROYAL SOCIETY OF ARTS, at 4.30.—Portugal as a Colonial Power: G. Young.

WEDNESDAY, MARCH 6.

GEOLOGICAL SOCIETY, at 5.30.—The Igneous Rocks of the Lake District: J. F. N. Green.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The Foundation of Industrial Peace: A. H. Paterson.

THURSDAY, MARCH 7.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—The Control of Large Amounts of Power: E. B. Wedmore.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Application of Charcoal to the Precipitation of Gold from its Solution in Cyanide: H. R. Edmands.—Blast-furnace Smelting of Stibnite, with considerations on the Metallurgy of Antimony: W. R. Schoeller.—A "Responsive" Shaft Signal Device: B. Angwin.

LINNEAN SOCIETY, at 5.—(1) The Mimetic and Mendelian Relationships of the "White Admirals" of North America (with Lantern Slides). (2) A New Mimetic Form of *Pseudacraea poggei* (Dewitz) from ex-German East Africa, with other African Mimics of *Danaida chrysippus* (Linn.): Prof. E. B. Poulton.—Mimetic Species of the African Nymphaline Genus Pseudacræa and Lycænid Genus Mimacræa, together with their Acræine and Danaidine Models and Some of their Co-mimics: Lord Rothschild.

FRIDAY, MARCH 8.

ROYAL INSTITUTION, at 5.30.—Vibrations: Mechanical, Musical, and Electrical: Prof. E. H. Barton.

SATURDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

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